



UNITED STATES PATENT AND TRADEMARK OFFICE

Case No. MBHB 01-099)

PATENT

In the Application of:

Rudger Rubbert

Group Art Unit: 2621

Serial No. 09/834,593

Filed: April 13, 2001

For: Scanning System and Calibration
Method for Capturing Precise
Three-Dimensional Information
of Objects

Confirmation no. 4535

RECEIVED
FEB 22 2002
Technology Center 2600

TRANSMITTAL LETTER

Box Non-fee amendment
Commissioner of Patents
Washington DC 20231

In regard to the above identified application:

1. We are transmitting herewith the attached :

1. Submission of Formal Drawings
2. 51 sheets of formal drawings
3. Return Postcard

2. With respect to additional fees:

- A. ☒ No additional fee is required.
- B. ☐ Attached is a check in the amount of \$ _____.
- C. ☐ Charge the total additional fee of \$ _____ to our Deposit Account No. 13-2490.

3. Please charge any additional fees or credit overpayment to Deposit Account No. 13-2490.
A duplicate copy of this sheet is enclosed.

4. **CERTIFICATE OF MAILING UNDER 37 CFR § 1.8:** The undersigned hereby certifies that this Transmittal Letter and the paper, as described in paragraph 1 hereinabove, are being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner of Patents, Box non-fee amendment, Washington, D.C. 20231, on this 3rd day of December, 2001.

By:

Thomas A. Fairhall

Reg. No. 34591



UNITED STATES PATENT AND TRADEMARK OFFICE
(Case No. MBHB 01-099)

PATENT

In the Application of:)

Rudger Rubbert)

Group Art Unit: 2621

Serial No. 09/834,593)

Filed: April 13, 2001)

For: Scanning System and Calibration)
Method for Capturing Precise)
Three-Dimensional Information)
of Objects)

Confirmation no. 4535)

#8
3-1-02
RECEIVED

FEB 22 2002

Technology Center 2600

SUBMISSION OF FORMAL DRAWINGS

Box Non-Fee Amendment
Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Applicants submit herewith 51 sheets of formal drawings for the above-referenced application. Approval of the drawings is requested.

Date: December 3, 2001

McDonnell Boehnen Hulbert & Berghoff
by: Thomas A. Fairhall
Thomas A. Fairhall
Reg. No. 34591



CERTIFICATE OF MAILING

The undersigned hereby certifies that the foregoing SUBMISSION OF FORMAL DRAWINGS is being deposited as first class mail, postage prepaid, in an envelope addressed to Box Non-Fee Amendment, Commissioner of Patents, Washington DC 20231, on this 3rd ~~th~~ day of December, 2001.

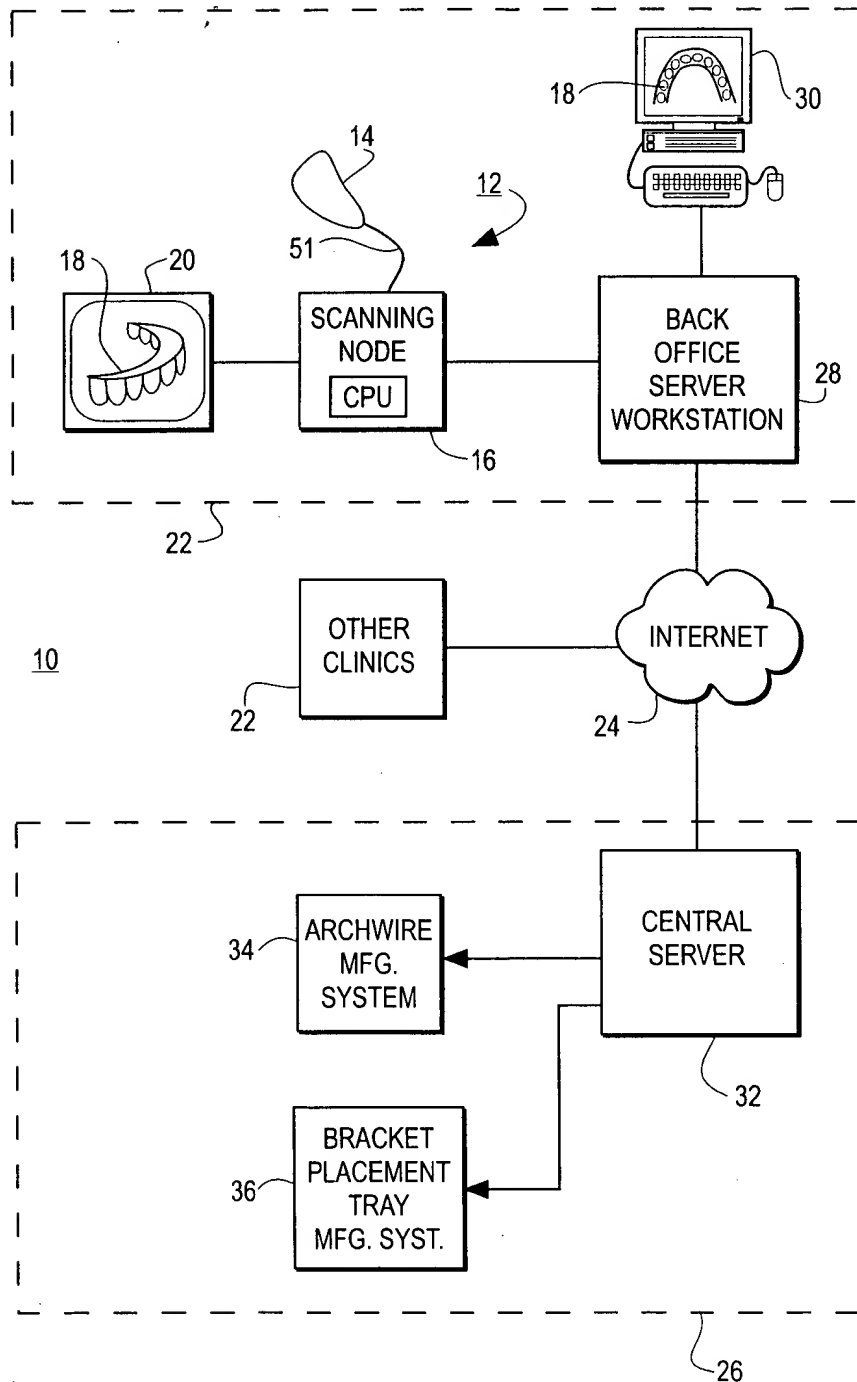
Thomas A. Fairhall

RECEIVED

FEB 22 2002

Technology Center 2600

FIG. 1



2/51

FIG. 2

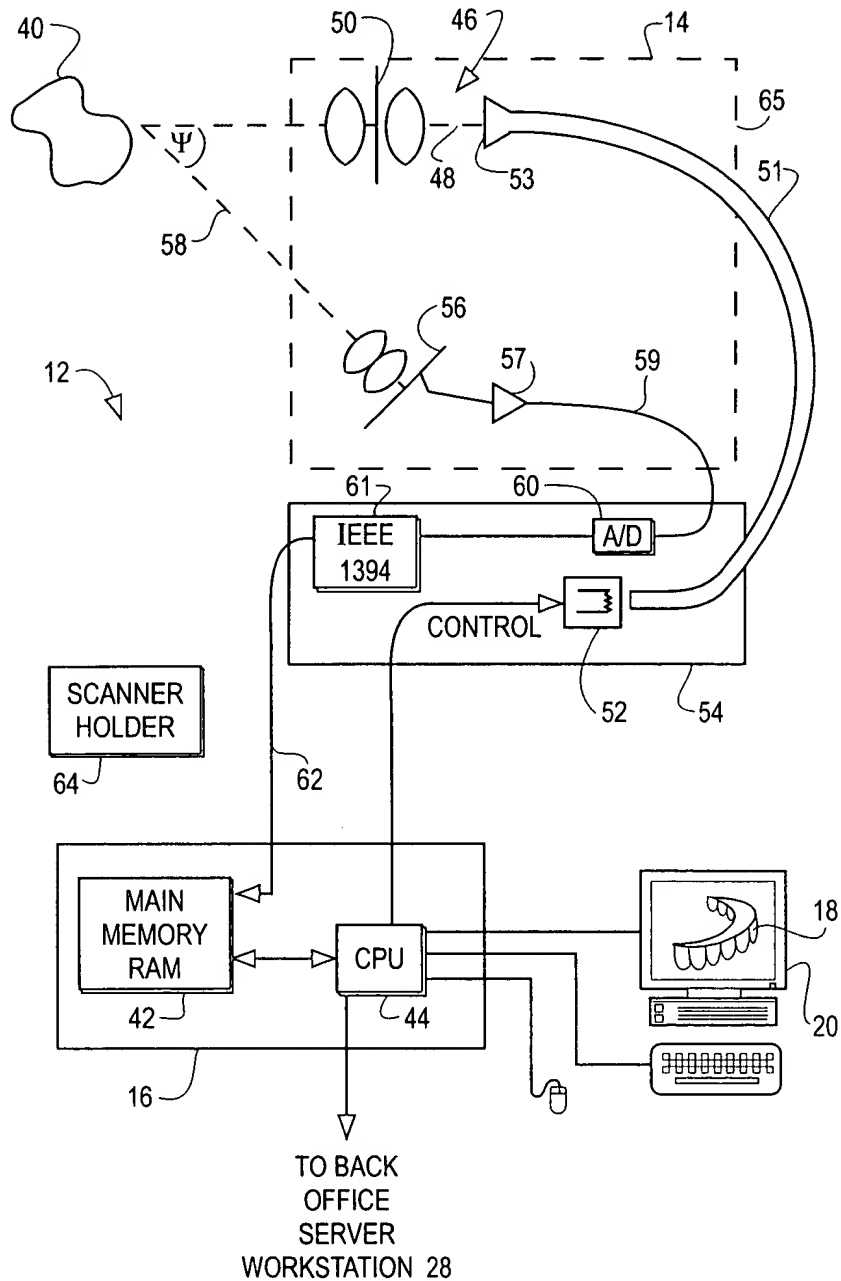


FIG. 3

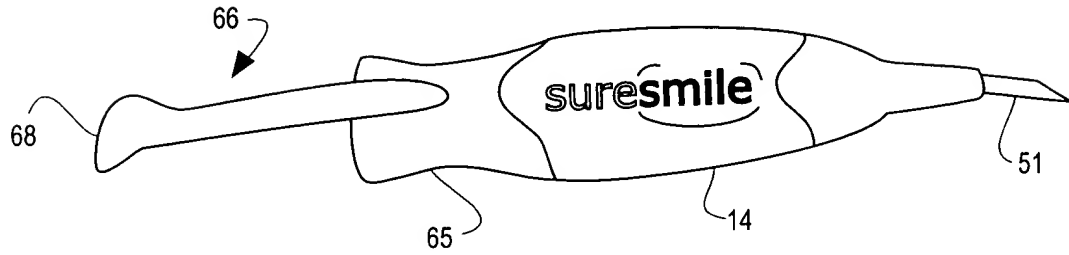


FIG. 4

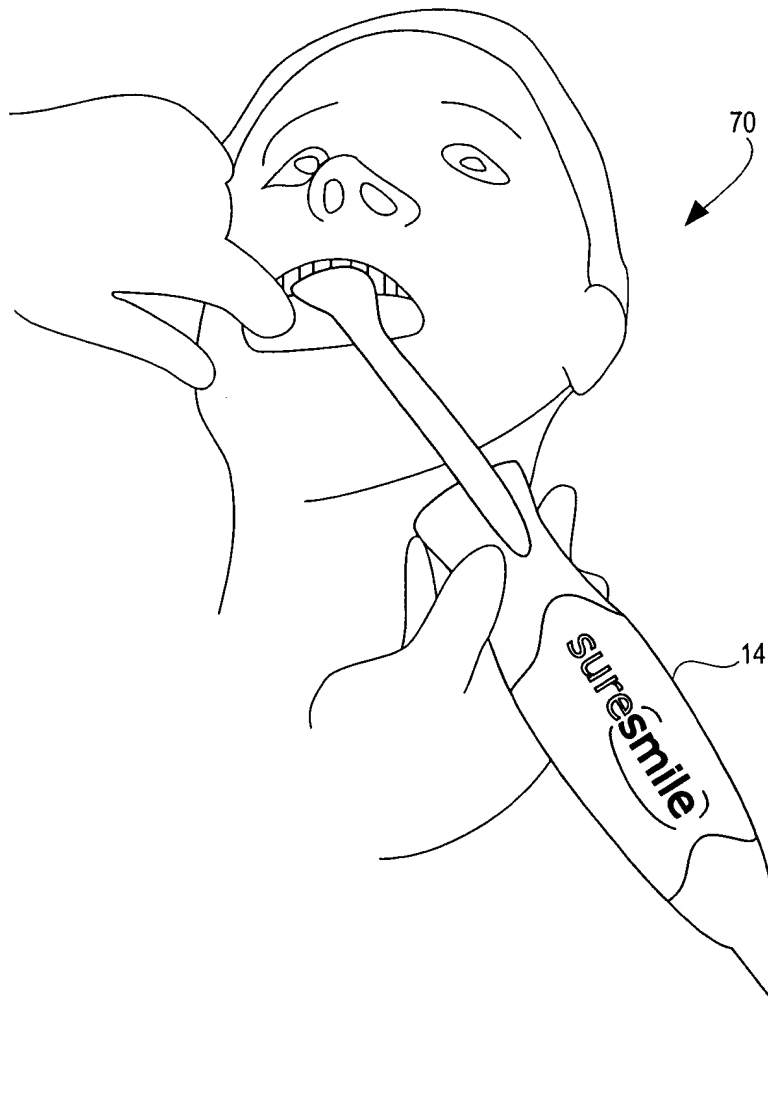


FIG. 5

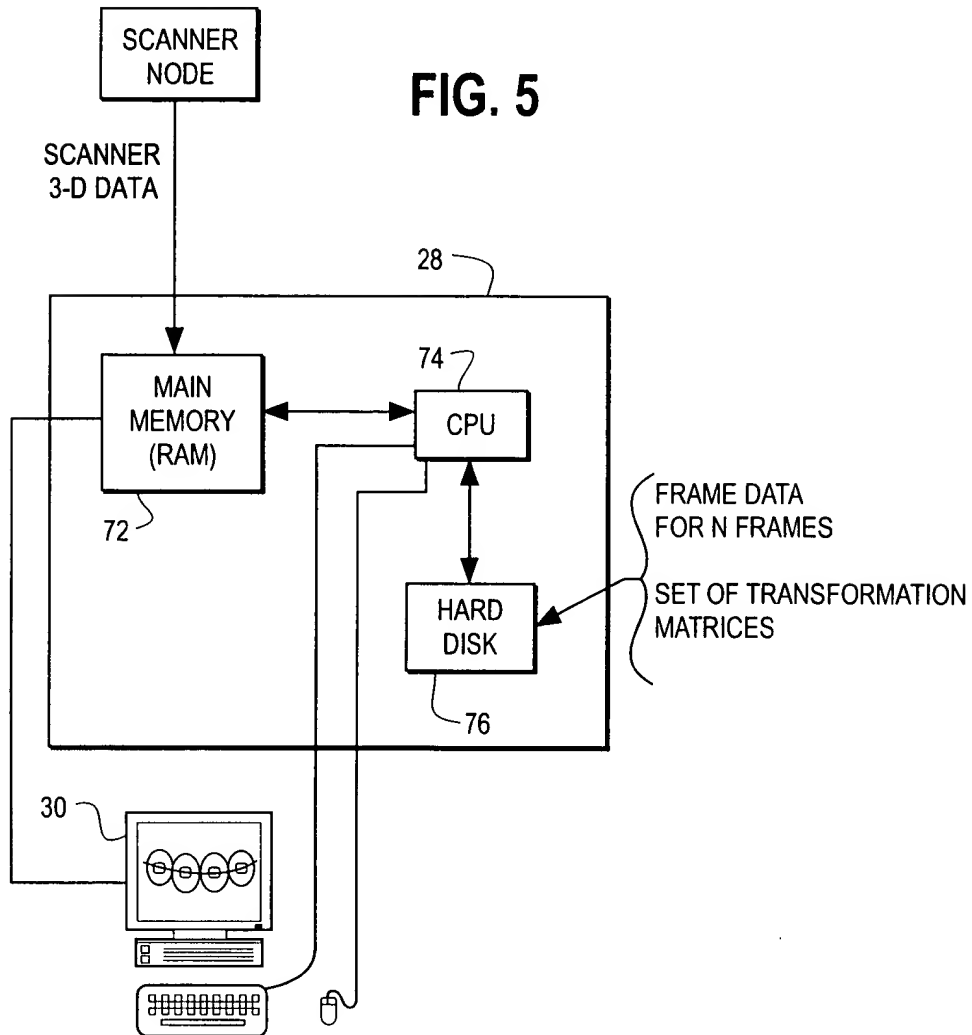
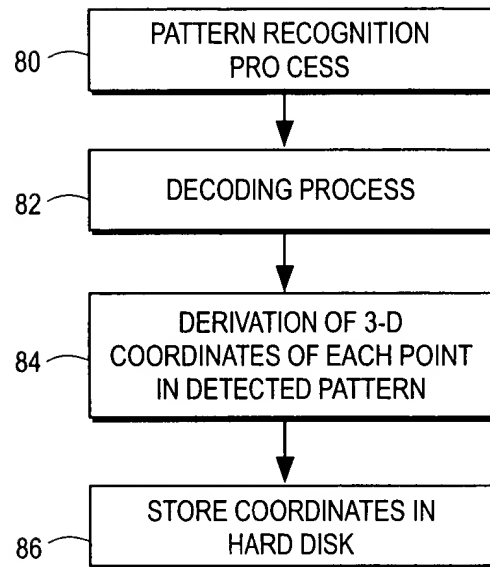


FIG. 6

3- DIMENSIONAL IMAGE CAPTURE (PER FRAME)



6/51

FIG. 7

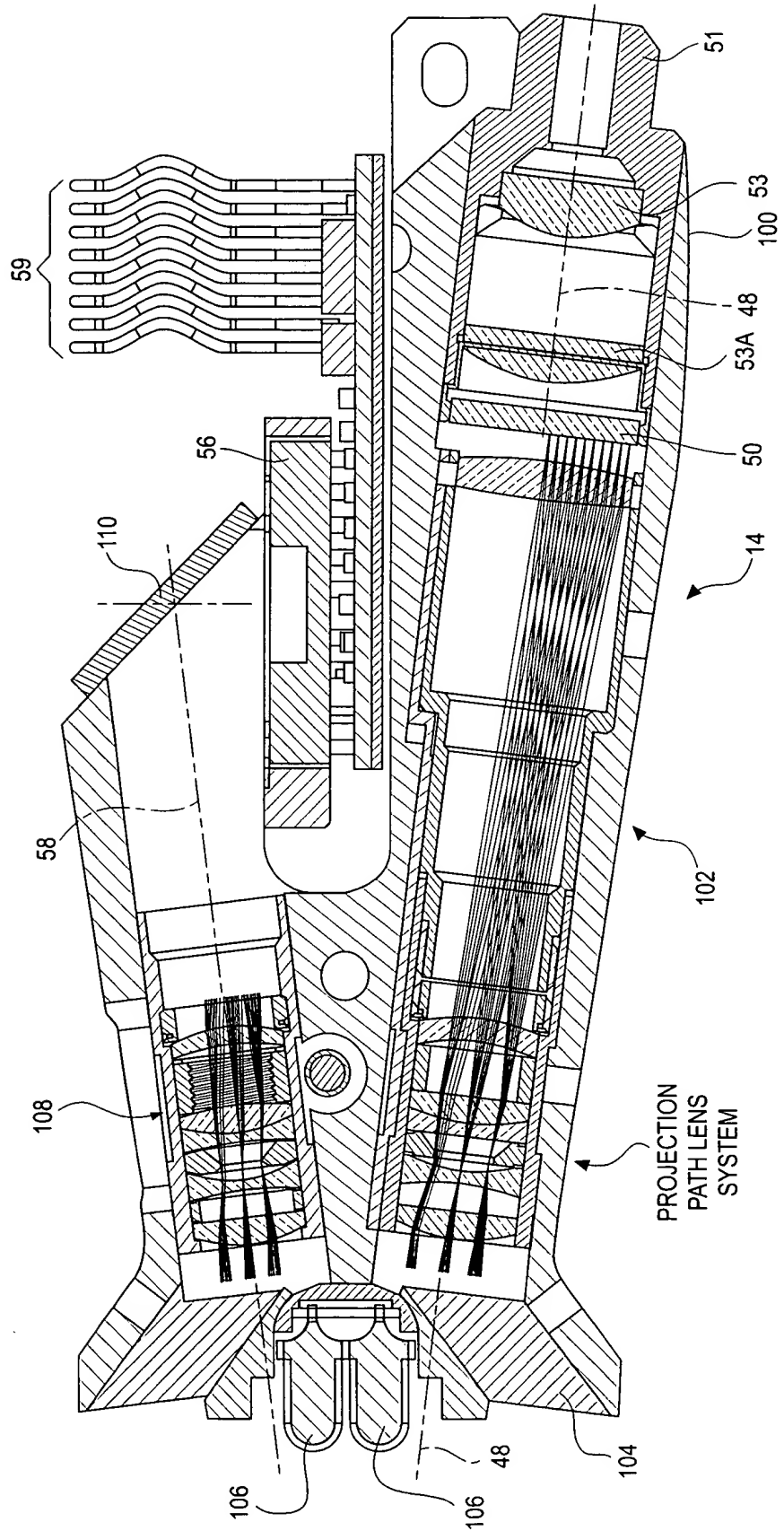


FIG. 8

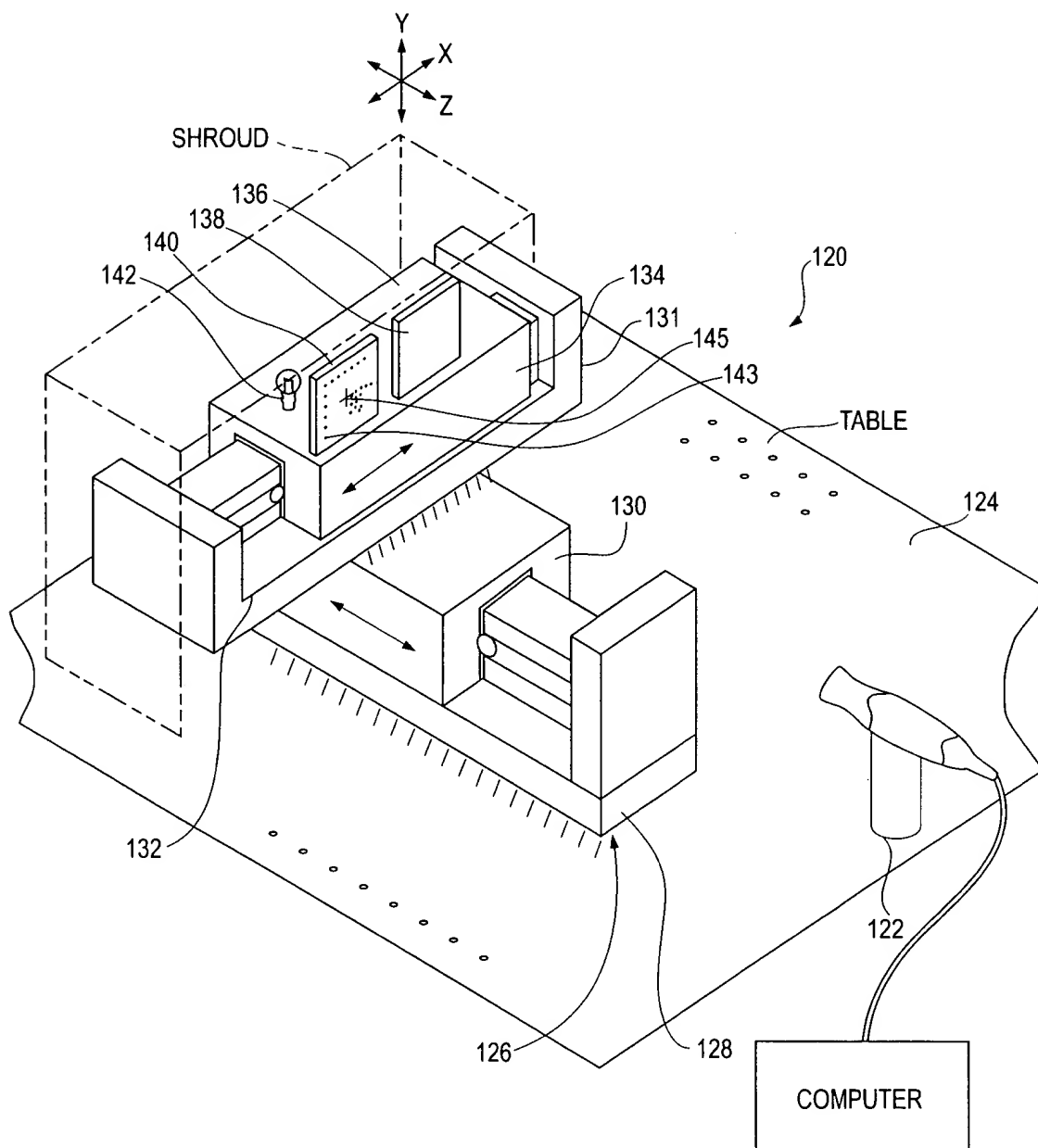


FIG. 8A

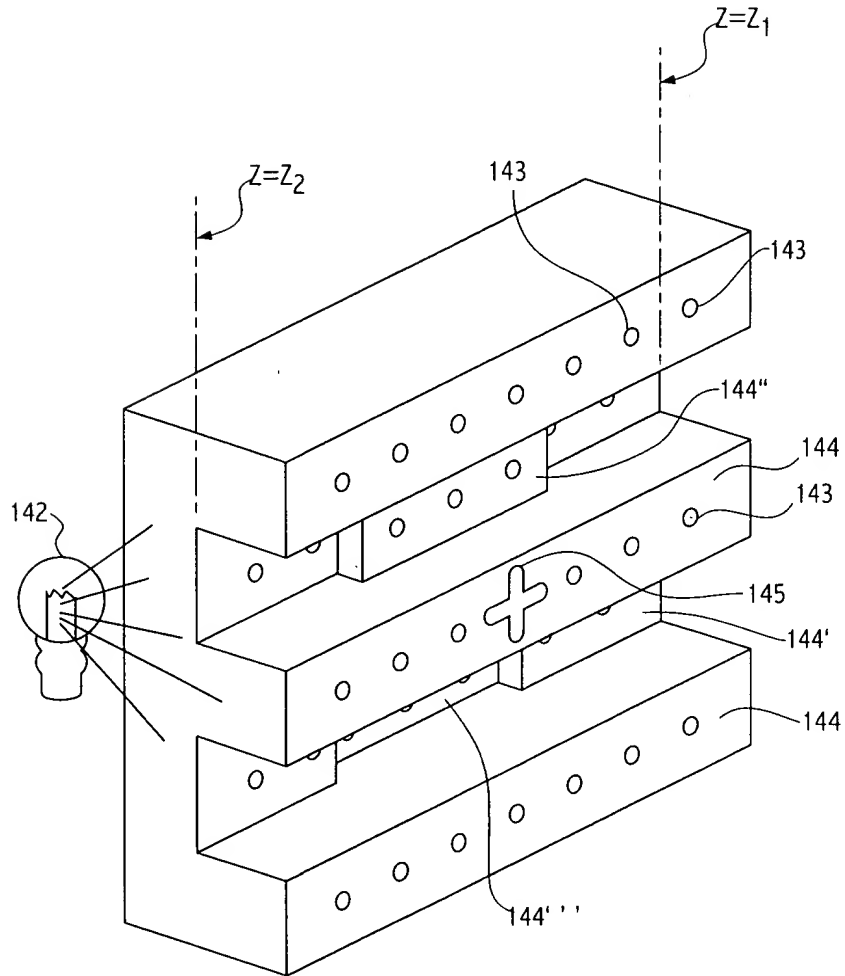
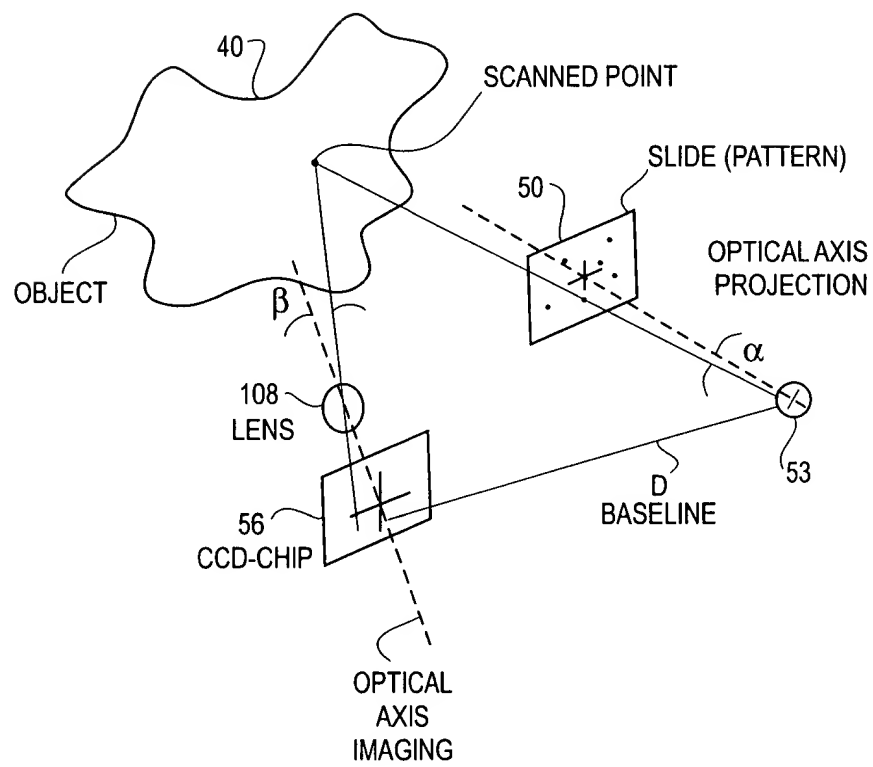


FIG. 9



10/51

FIG. 9A

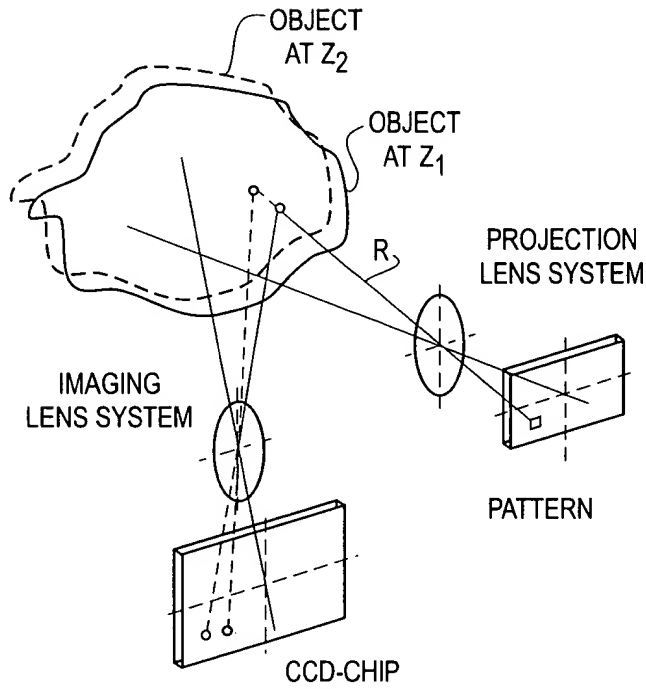


FIG. 9B

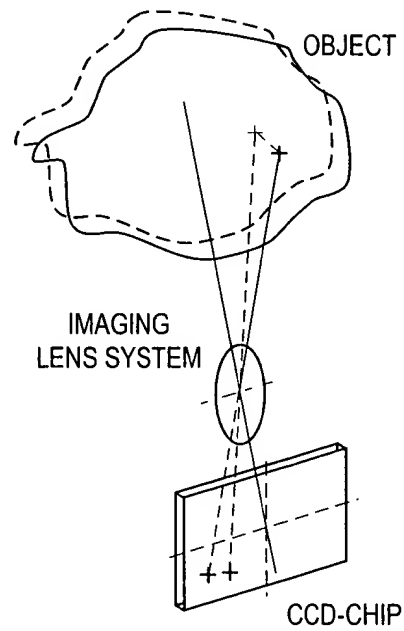
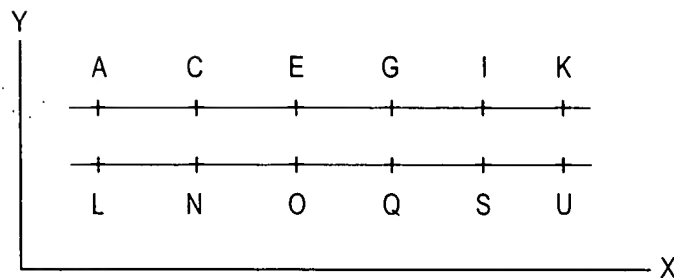
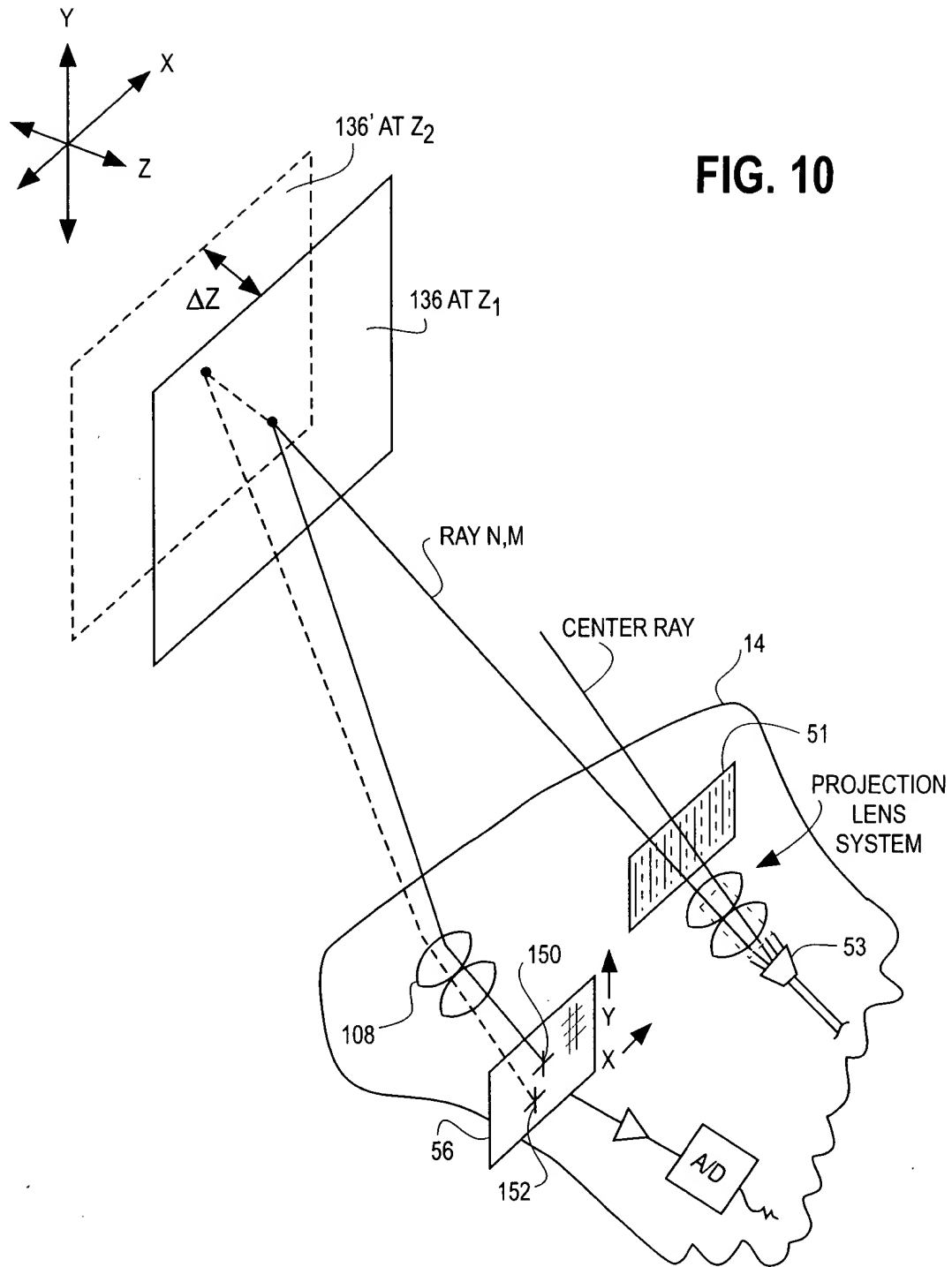


FIG. 9C



PIXEL COORDINATES FOR PORTIONS OF THE PATTERN ASSIGNED TO A CERTAIN Z-LEVEL



12/51

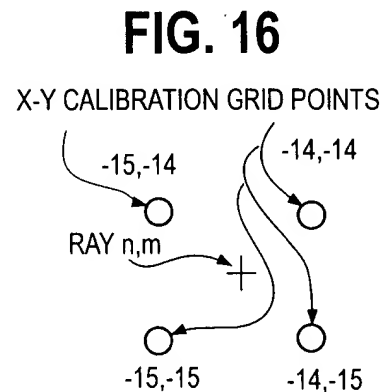
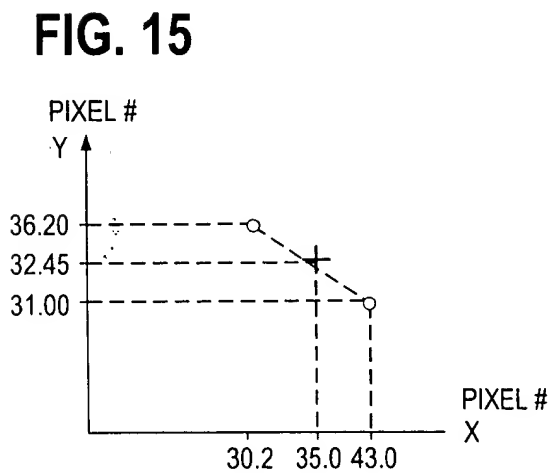
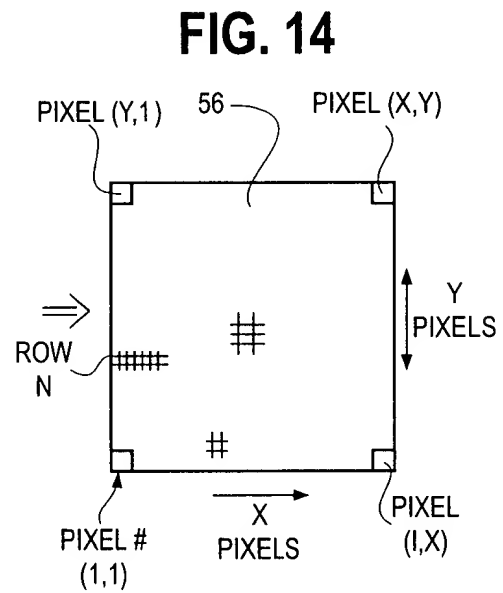
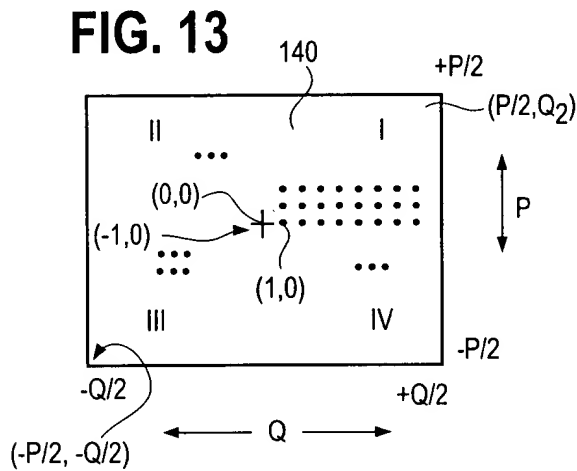
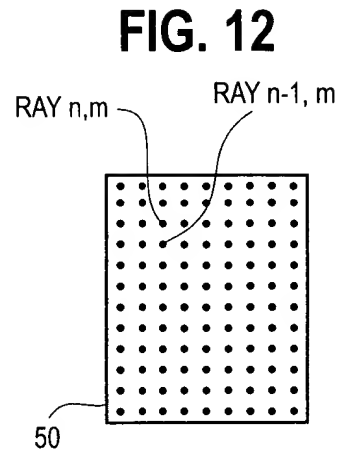
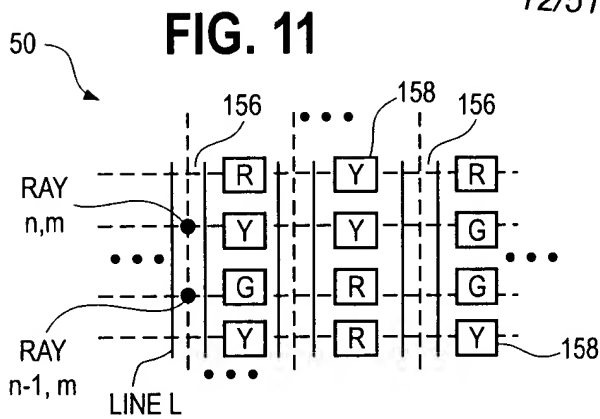


FIG. 17

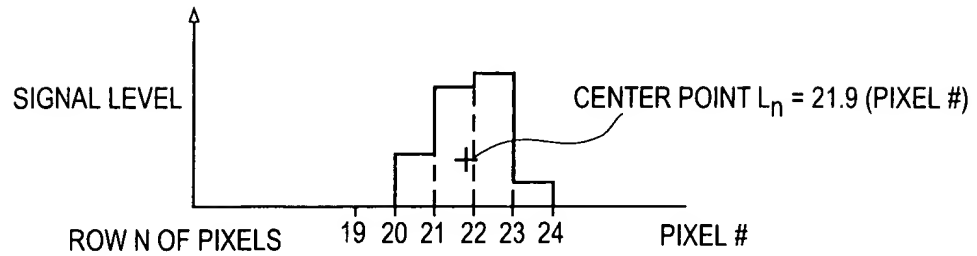


FIG. 18

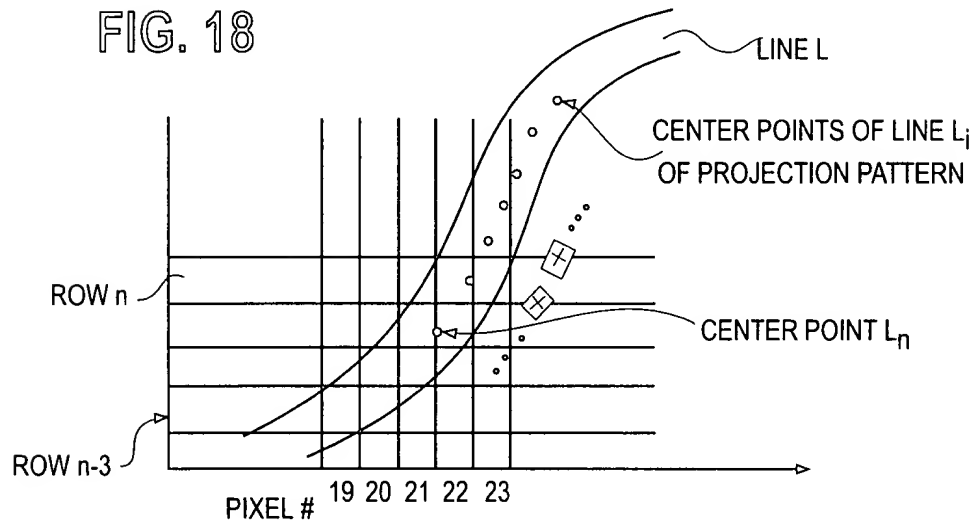


FIG. 19

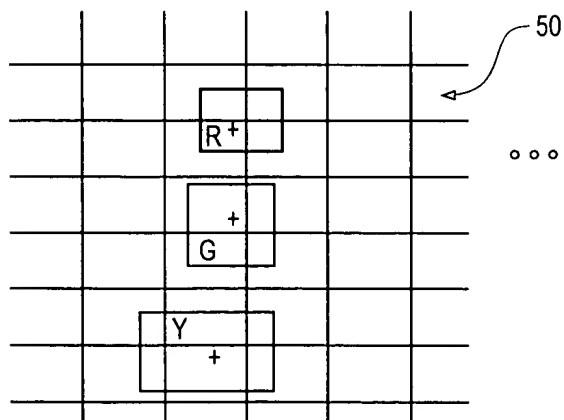


FIG. 20

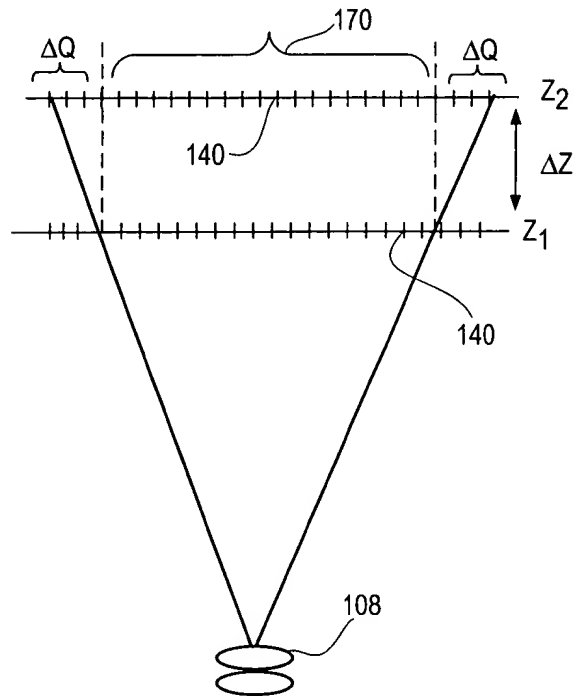


FIG. 21

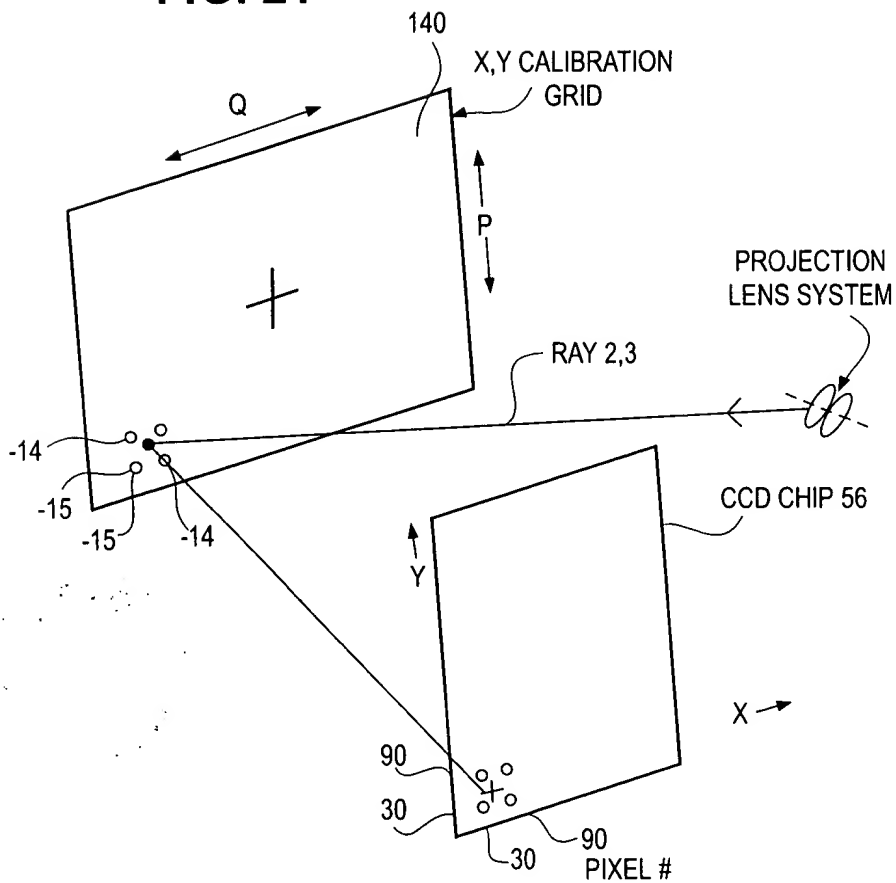


FIG. 23

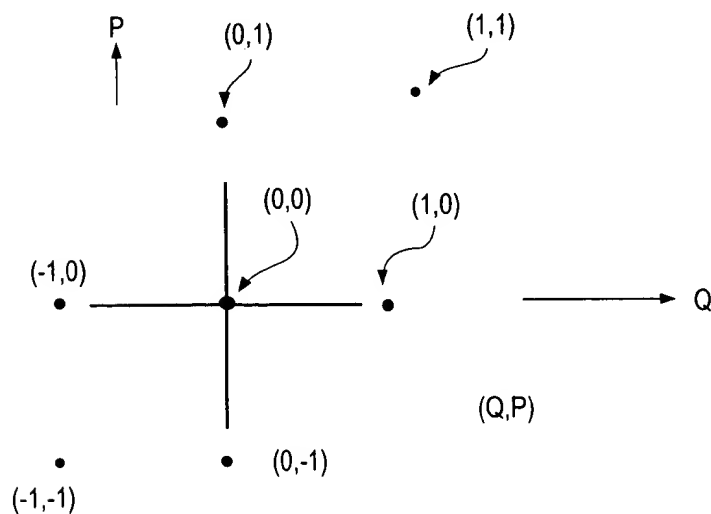


FIG. 24

CCDX, CC DY = PIXEL #, IN SUBPIXEL RESOLUTION

(BEFORE)

CALIBRATION TABLE #1

	LINE 1				LINE 2				LINE N			
	ROW 1	ROW 2	ROW 3	ROW 4	ROW M	ROW 1	ROW 2	ROW 3	ROW 4	ROW M	ROW 1	ROW 2
CCDX	1.0	1.1	1.5	2.1	...	27.1	29.5	30.2	37.1			
MM												
DIST.												
CCDY	10.2	20.4	32.8	44.5		11.5	21.6	36.2	44			
MM												
DIST.												
CCDX	3.9	4.5	6.8	12.2		34.0	41.1	43.0	46			
MM												
DIST.												
CCDY	12.1	21.5	30.4	46.3		13.2	21.8	31.0	48.2			
MM												
DIST.												

Z₁

Z₂

FIG. 26

CCD_X, CCD_Y = PIXEL #, IN SUBPIXEL RESOLUTION

CALIBRATION TABLE #1 (AFTER)

	PATTERN				PATTERN								LINE N																				
	LINE 1				LINE 2																												
	ROW 1	ROW 2	ROW 3	ROW 4	ROW 1	ROW 2	ROW 3	ROW 4	ROW 1	ROW 2	ROW 3	ROW 4	ROW 1	ROW 2	ROW 3	ROW 4	ROW 1	ROW 2	ROW 3	ROW 4	ROW 1	ROW 2	ROW 3	ROW 4	ROW 1	ROW 2	ROW 3	ROW 4	ROW 1	ROW 2	ROW 3	ROW 4	
CCD _X	1.0	1.1	1.5	2.1					000					27.1	29.5	30.2	37.1																
MM DIST.																-14.6																	
CCD _Y	10.2	20.4	32.8	44.5										11.5	21.6	36.2	44																
MM DIST.																-14.4																	
CCD _X	3.9	4.5	6.8	12.2										34.0	41.1	43.0	46																
MM DIST.																-14.8																	
CCD _Y	12.1	21.5	30.4	46.3										13.2	21.8	31.0	48.2																
MM DIST.																-15.8																	

Z₁

Z₂

19/51

Fig. 27

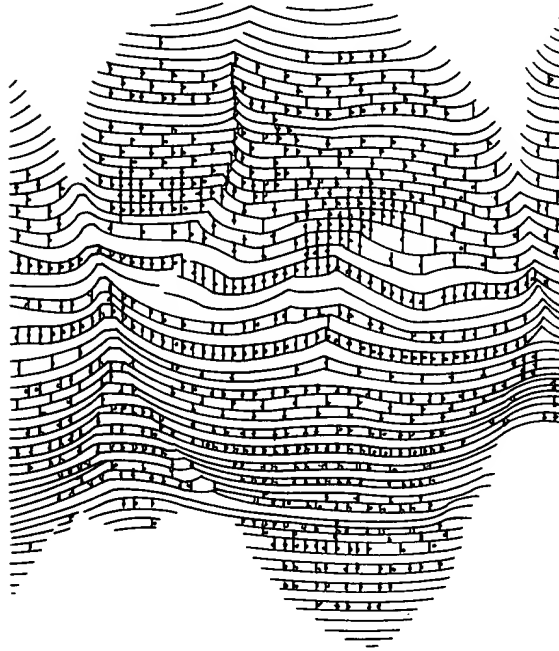


Fig. 28

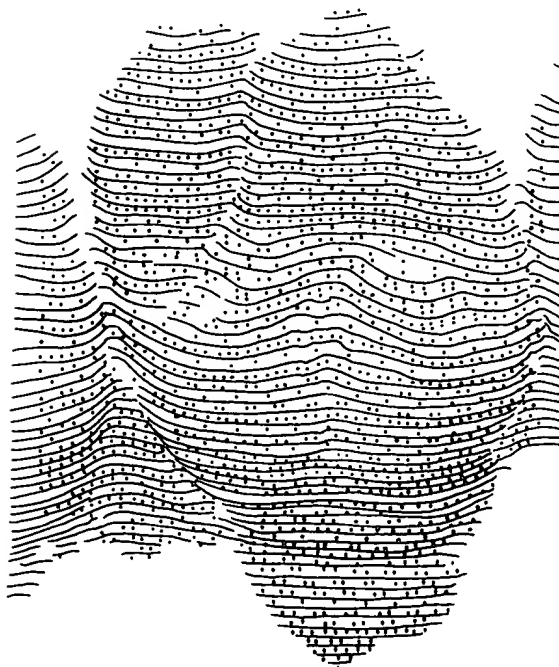


Fig. 29



Fig. 30

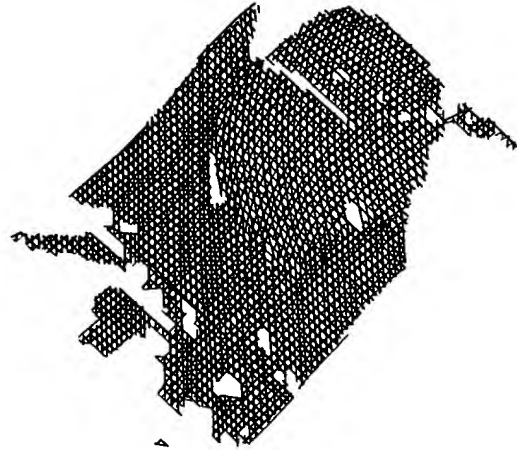


Fig. 31



Fig. 32

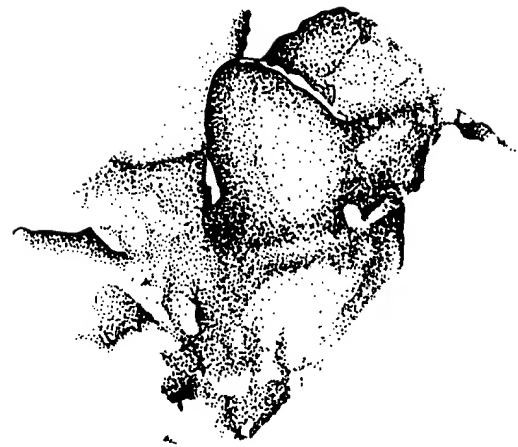


Fig. 33



Fig. 34

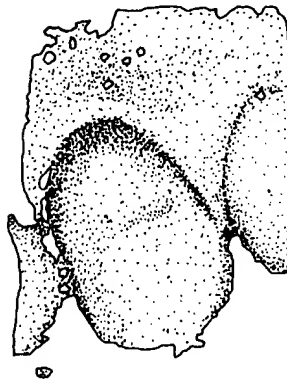


Fig. 35

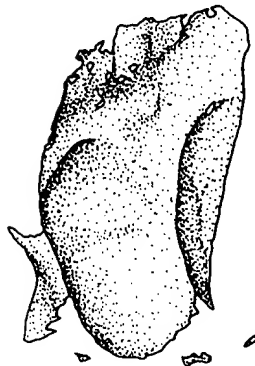
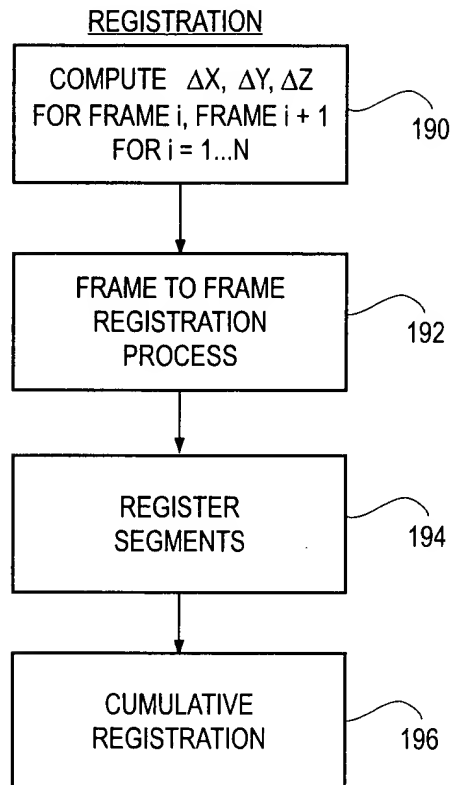


FIG. 36



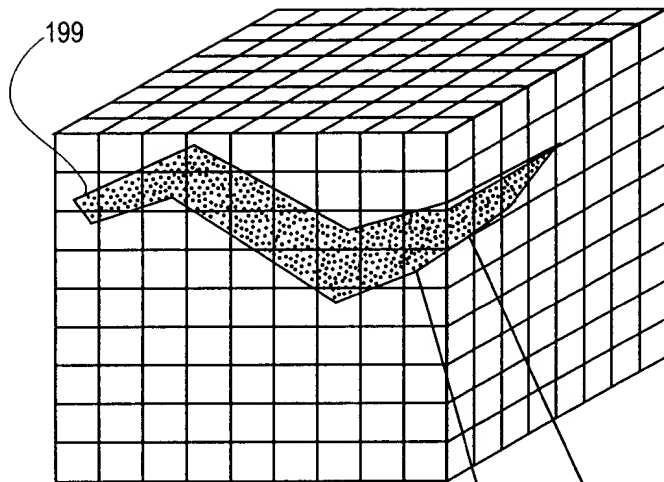
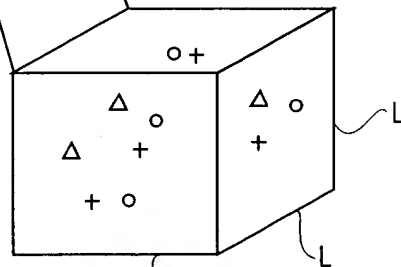


FIG. 37A

FIG. 37B



L = 1.0 mm

Δ = POINTS OF FRAME i
+ = POINTS OF FRAME $i + 1$
o = POINTS OF FRAME $i + 2$

MBHB 01-099 09/834,593

FIG. 37C.

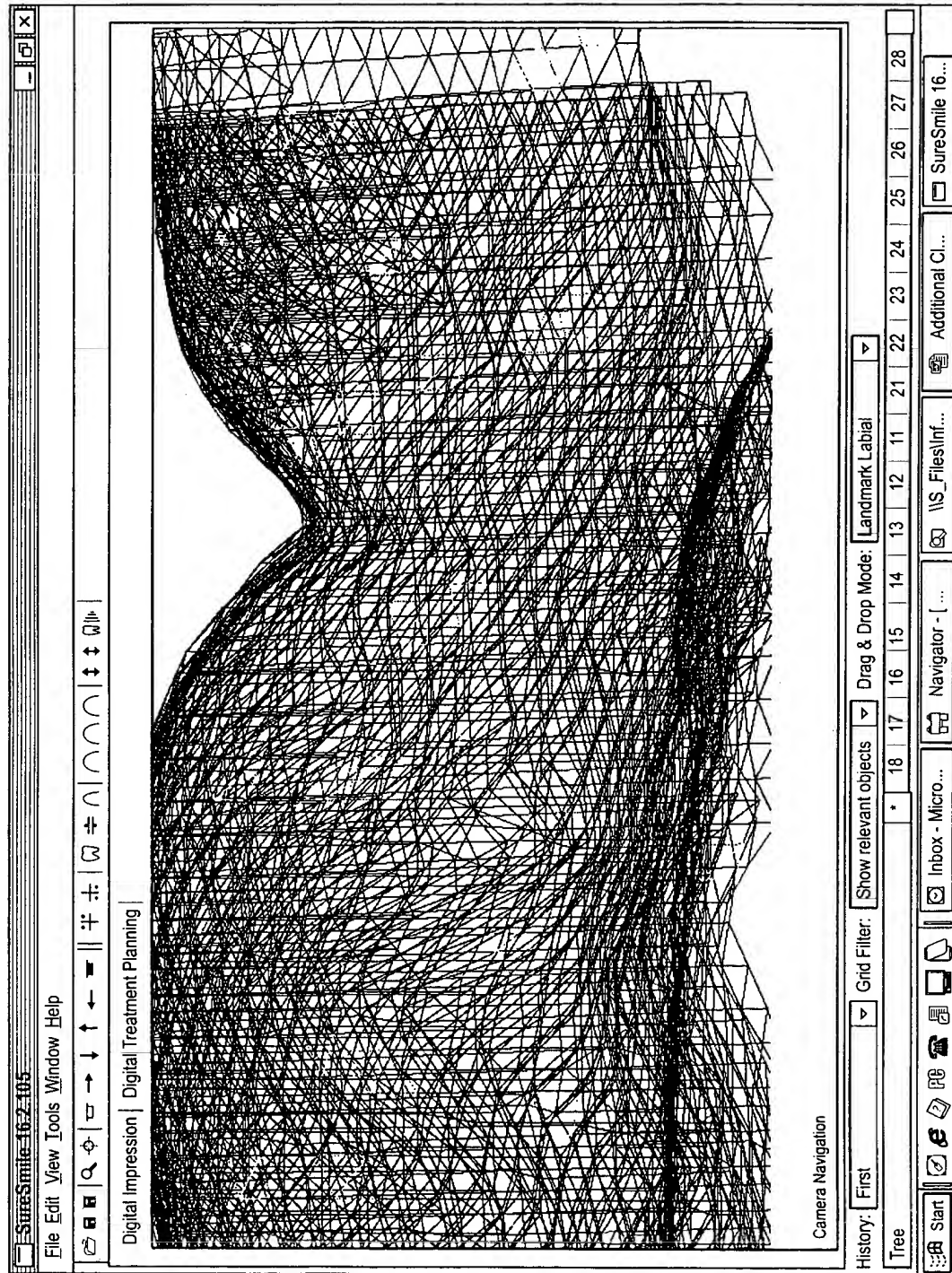


FIG. 37D

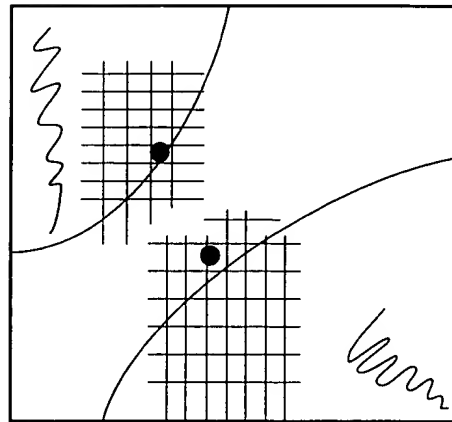


FIG. 38A

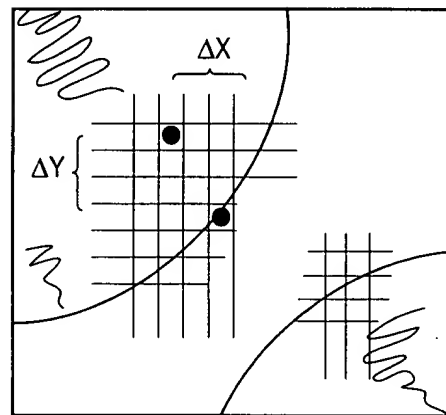


FIG. 38B

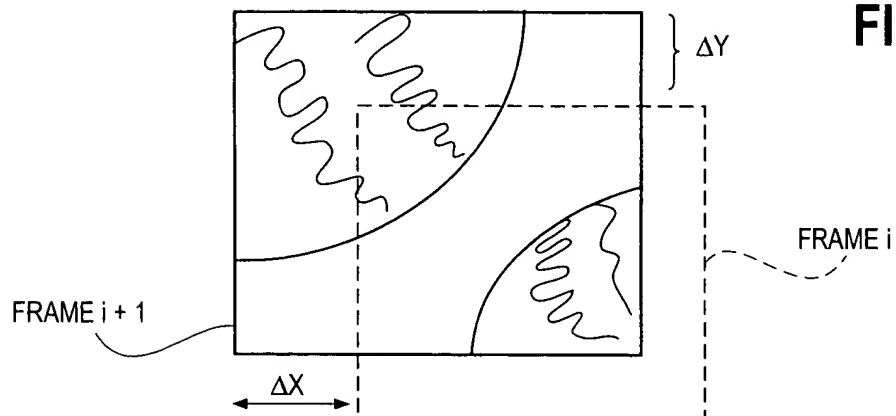


FIG. 38C

FIG. 39A

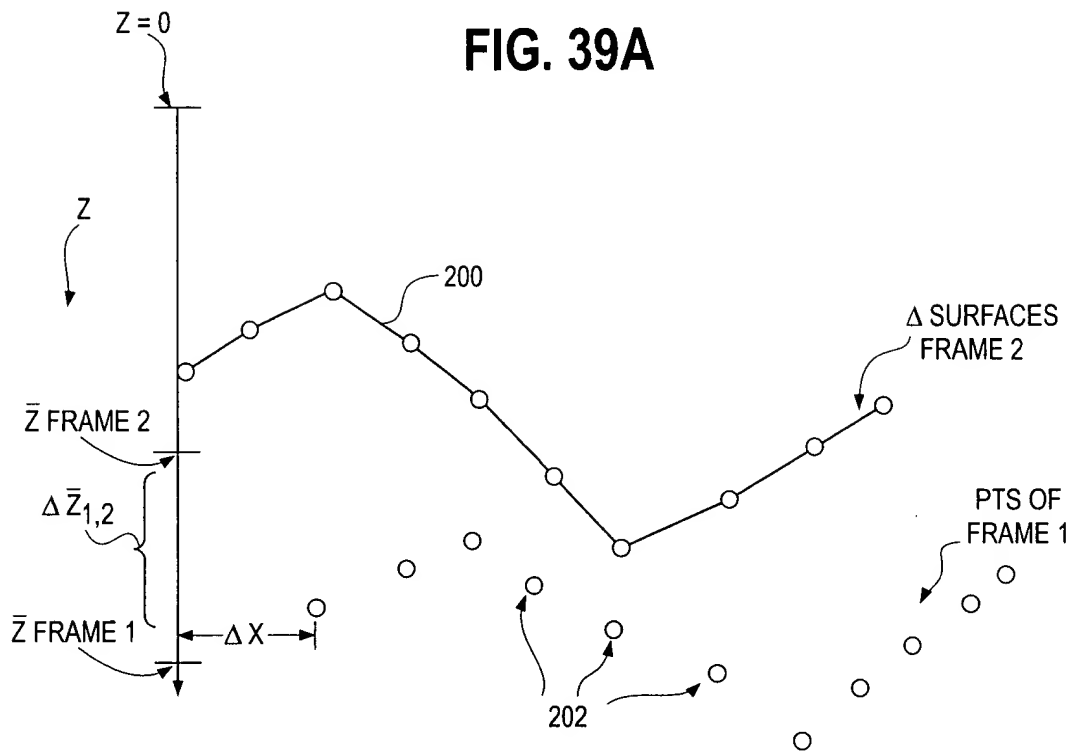


FIG. 39B

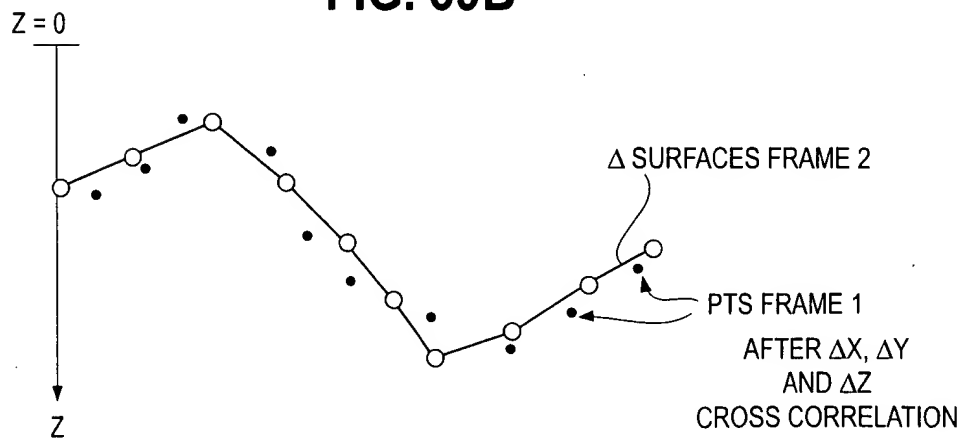


FIG. 40A

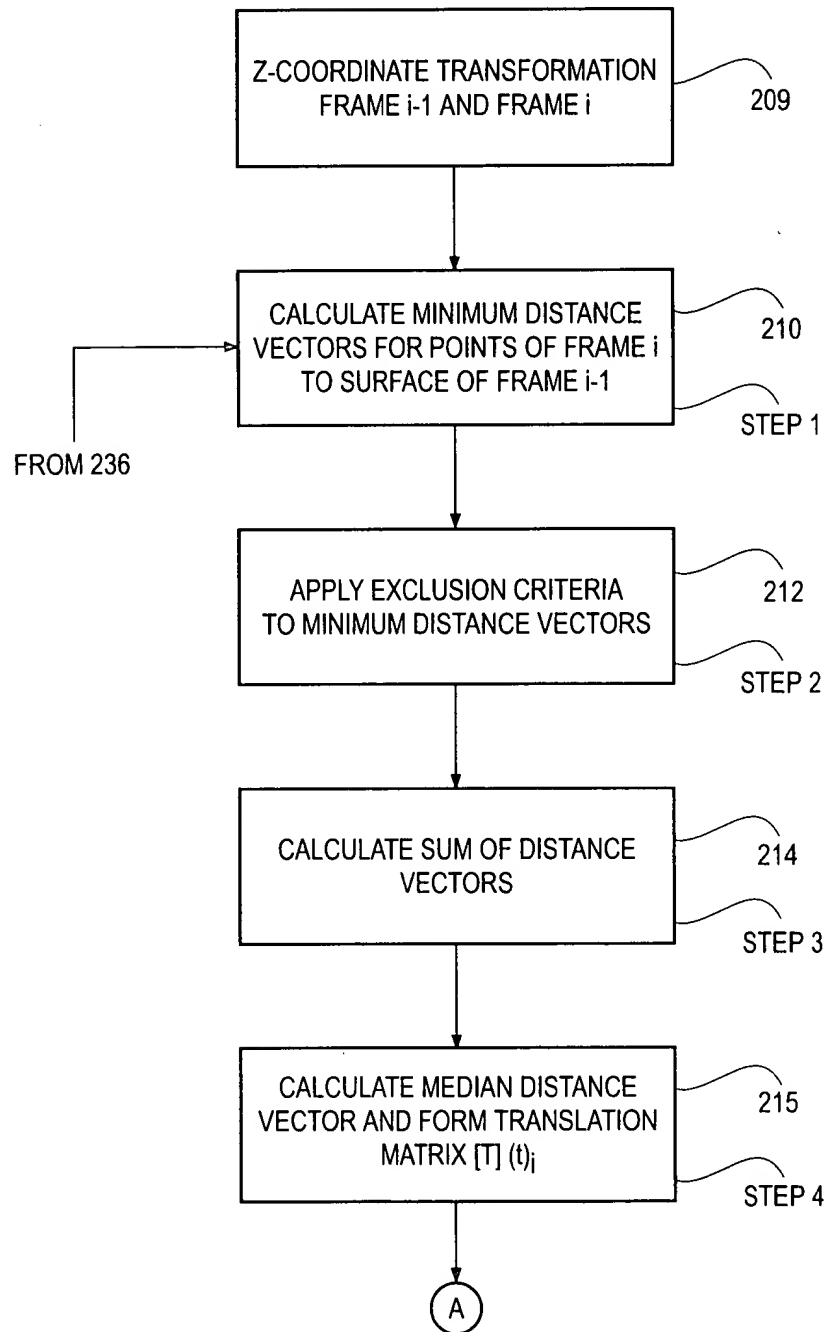


FIG. 40B

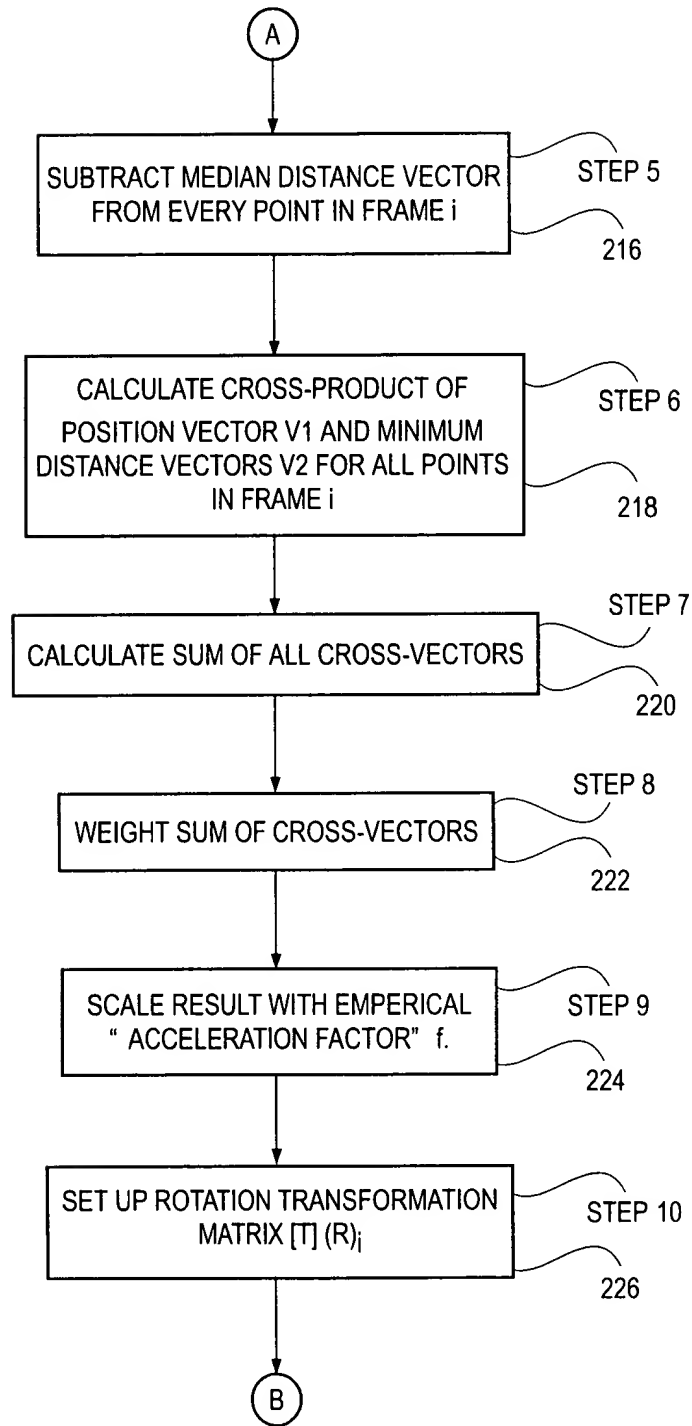


FIG. 40C

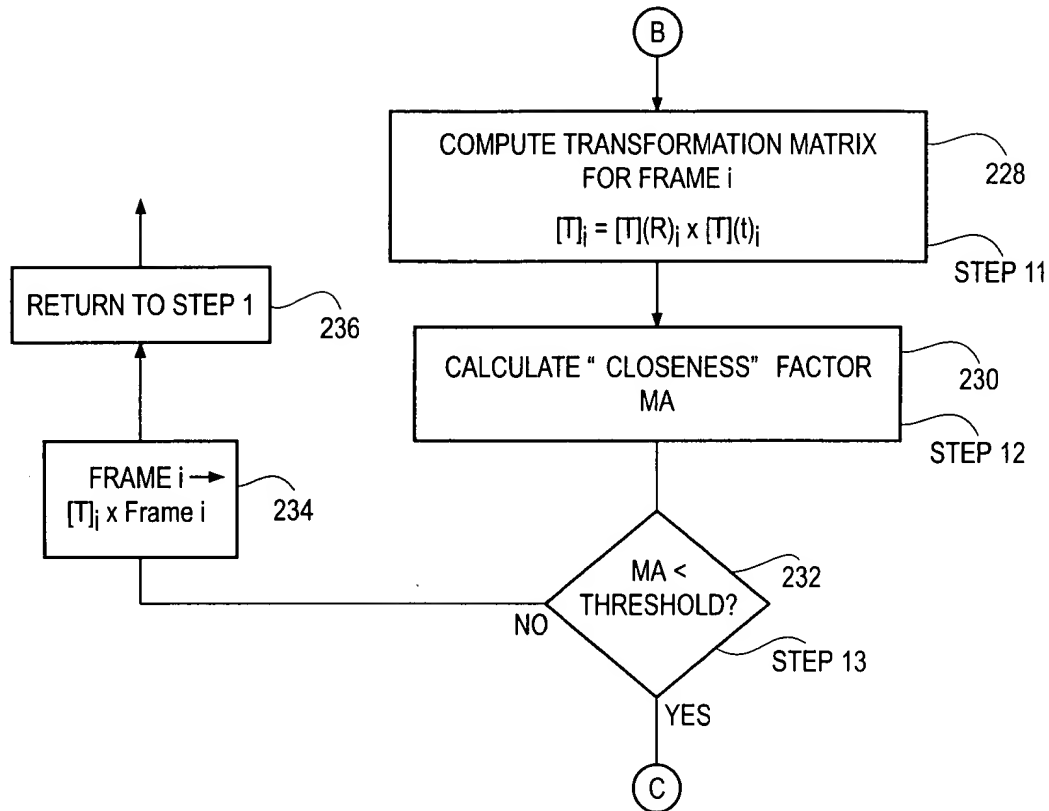
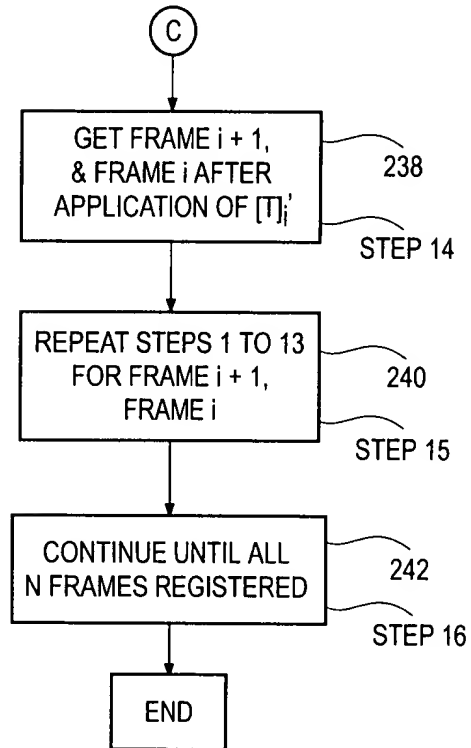


FIG. 40D



32/51

FIG. 41

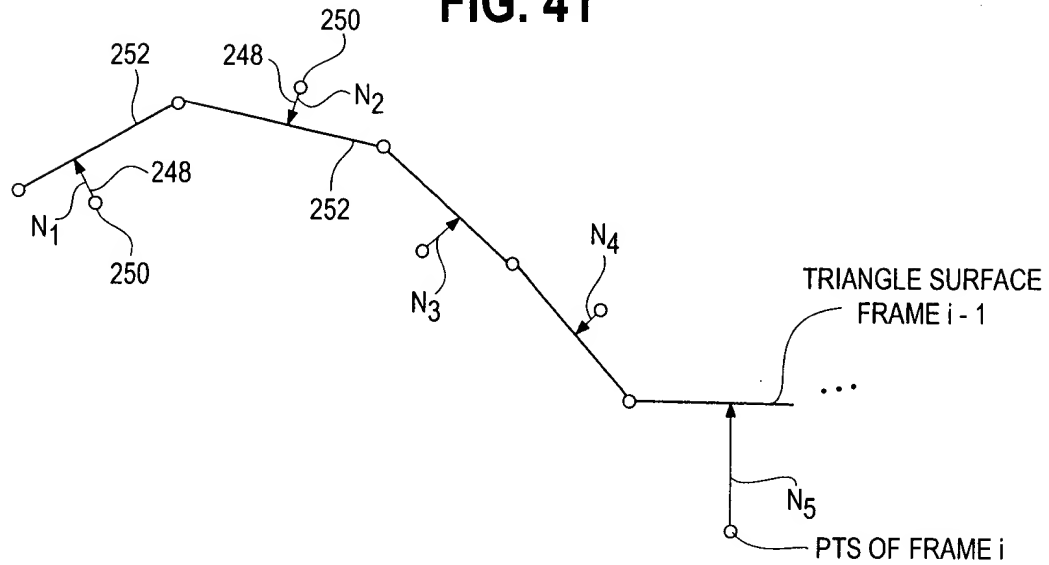


FIG. 42

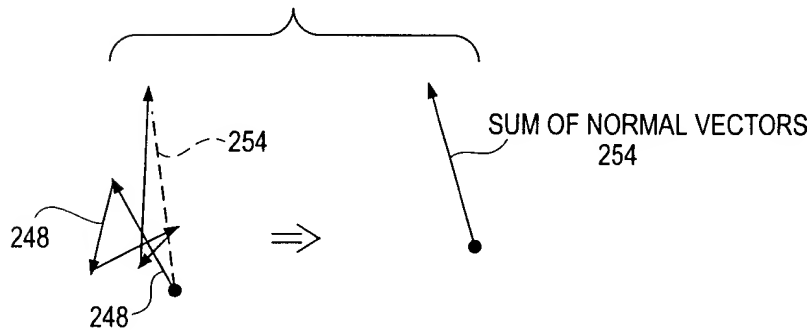


FIG. 43

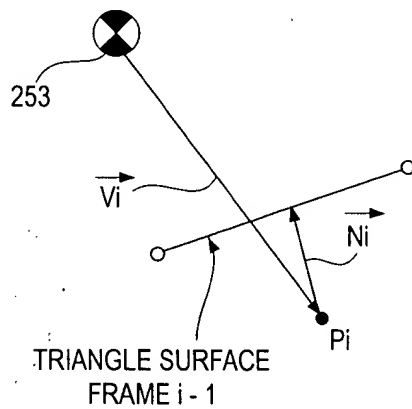
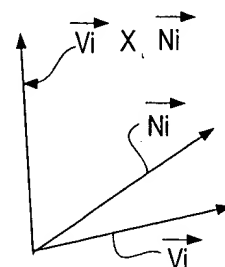


FIG. 44



33/51

FIG. 45

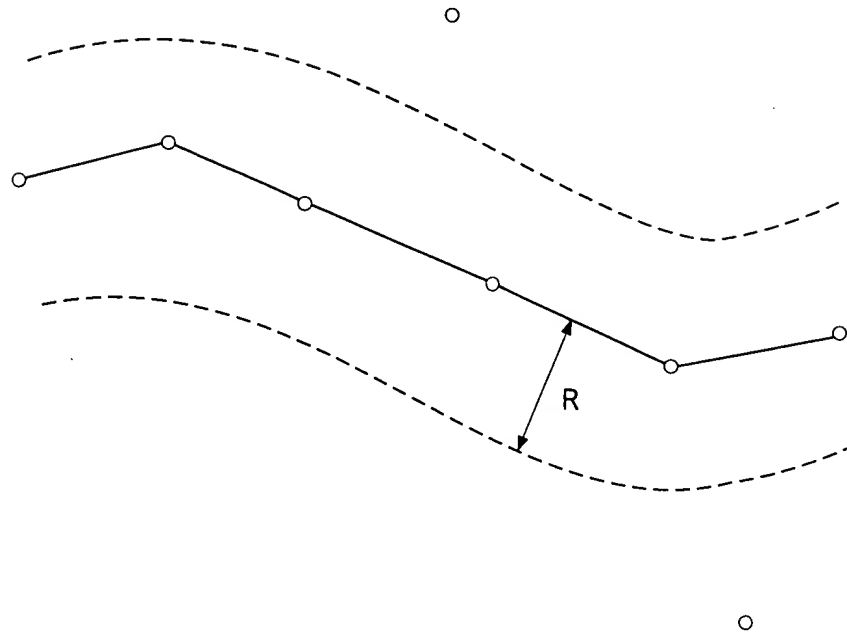
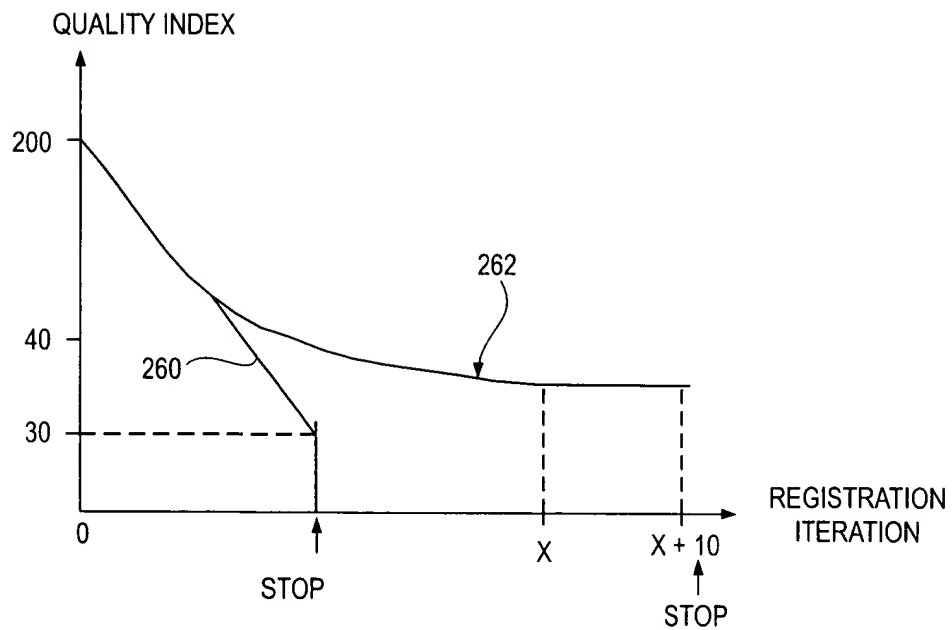


FIG. 46



34/51

FIG. 47A

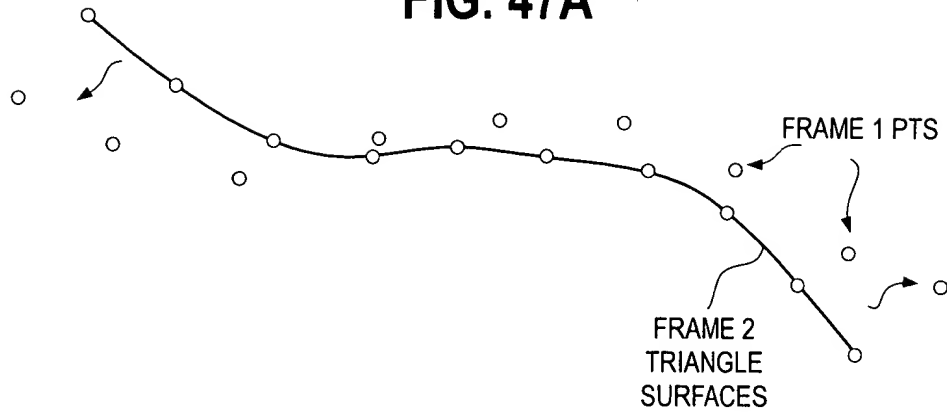
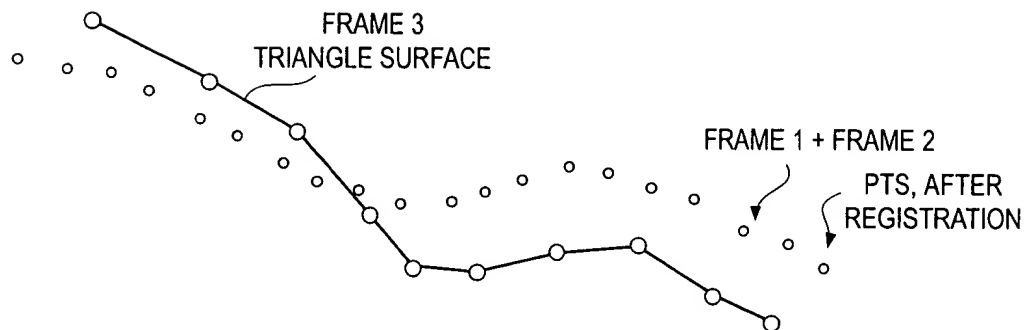


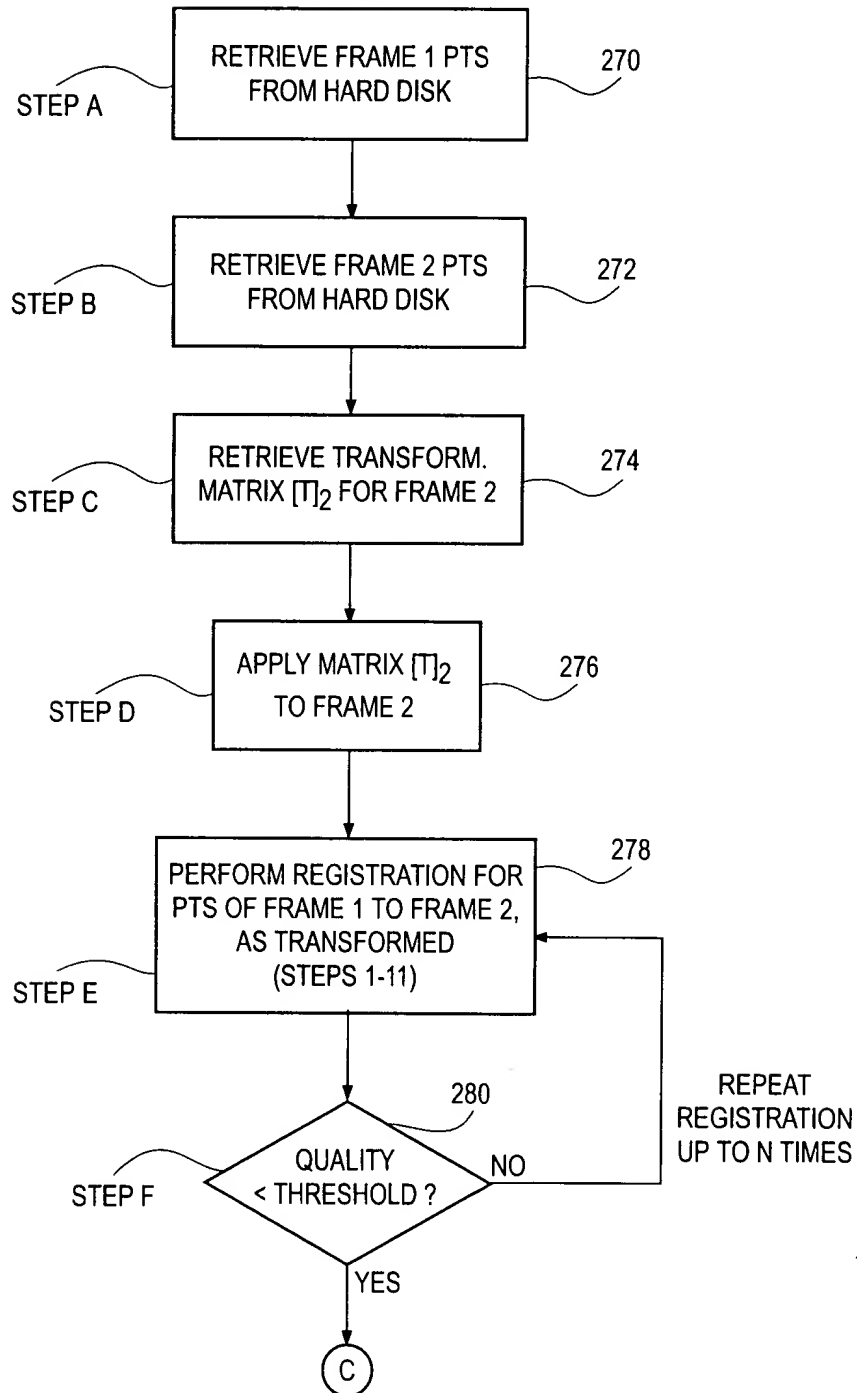
FIG. 47B



35/51

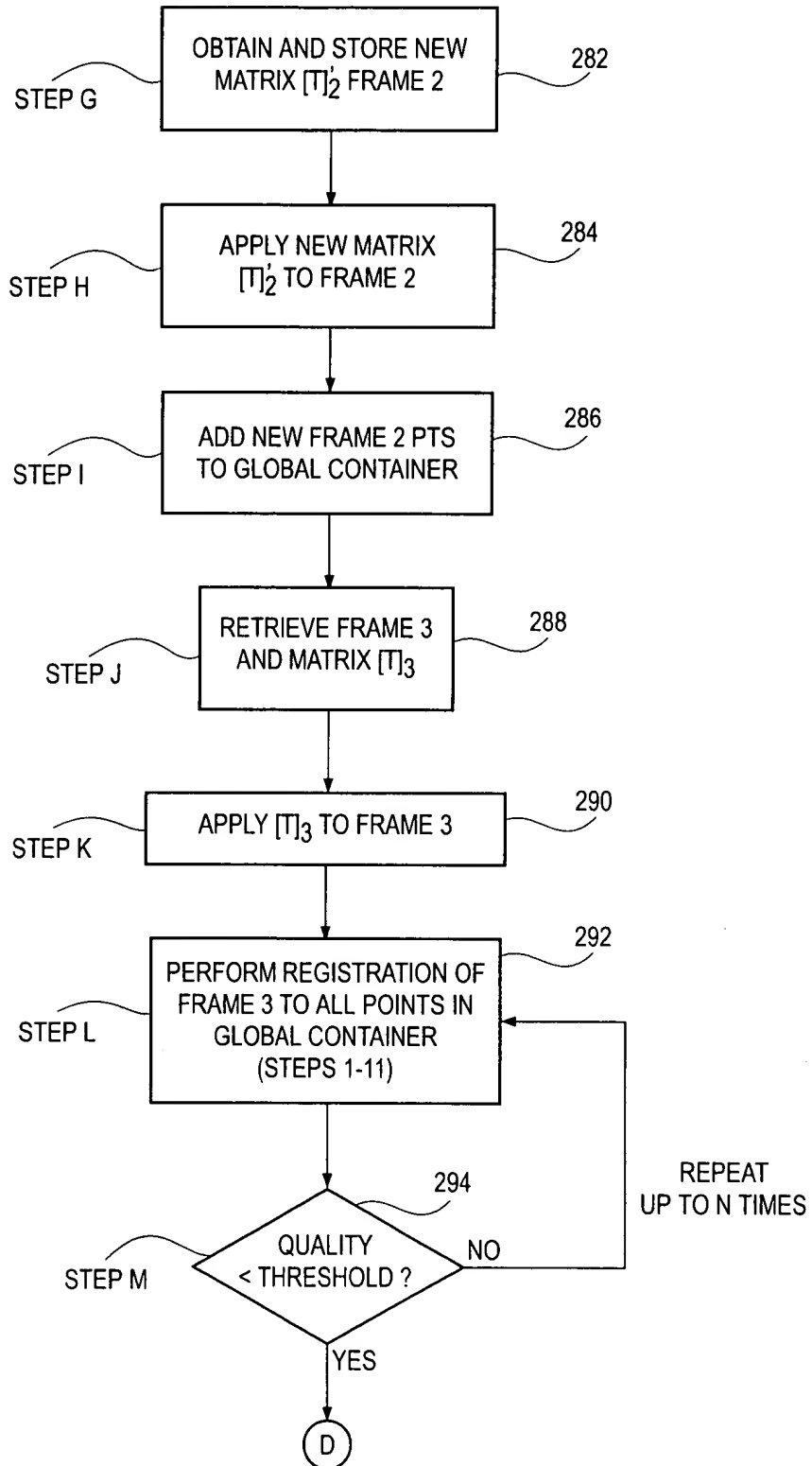
FIG. 48A

CUMULATIVE REGISTRATION



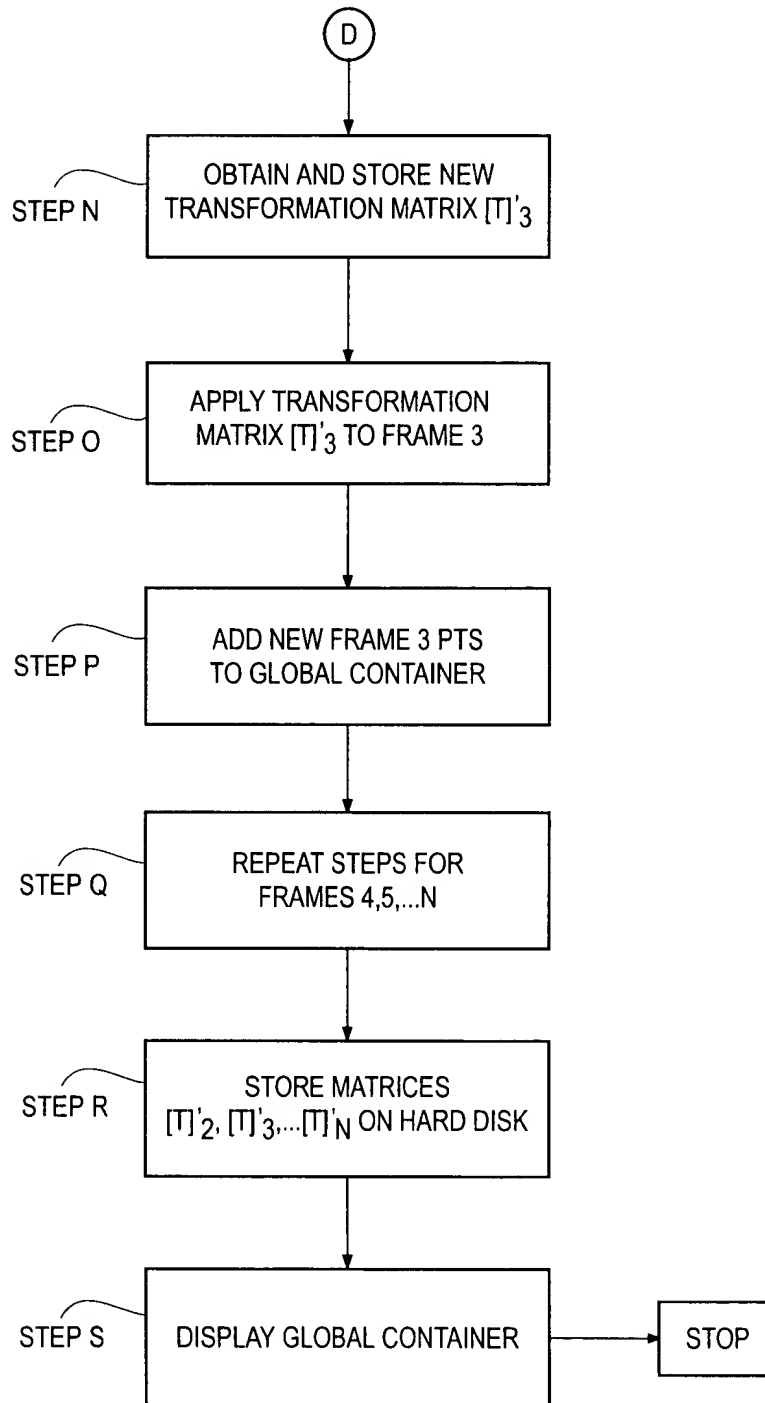
36/51

FIG. 48B



37/51

FIG. 48C



38/51

FIG. 49

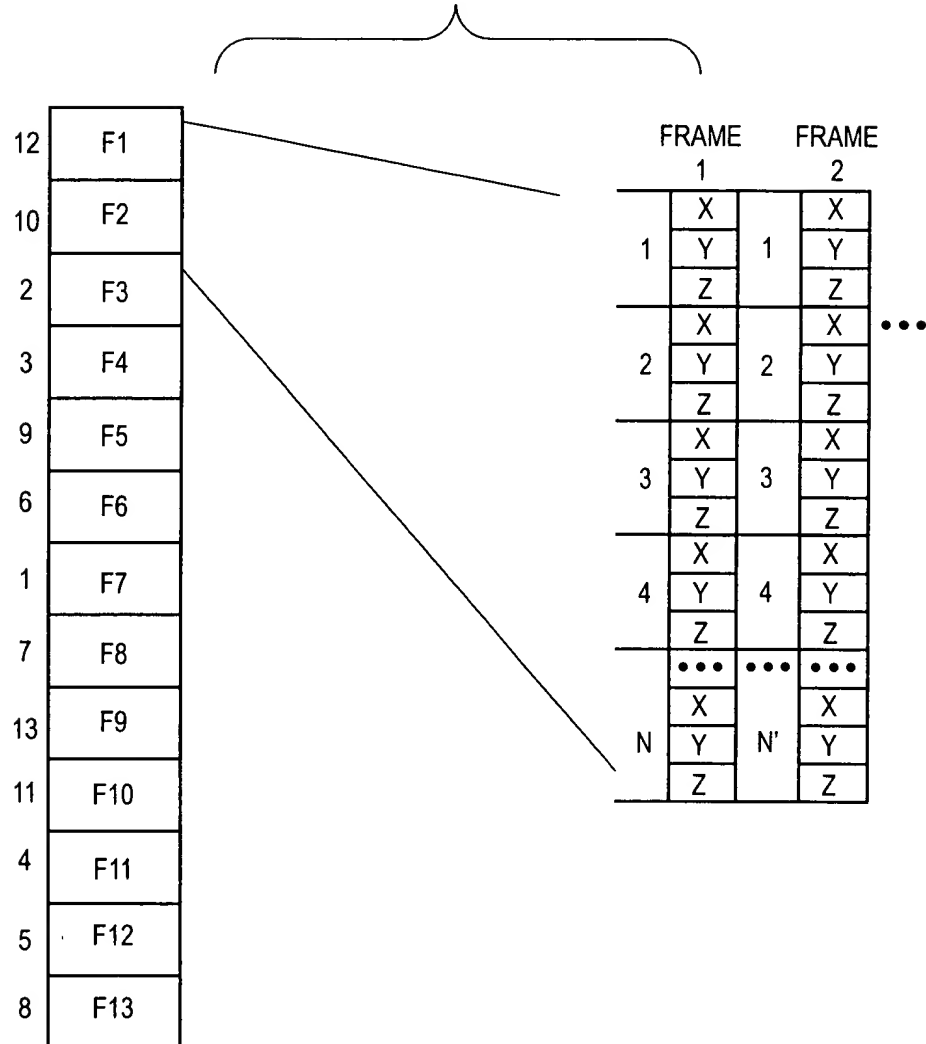
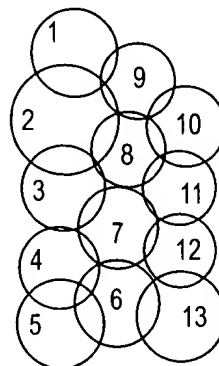


FIG. 50



39/51

FIG. 51

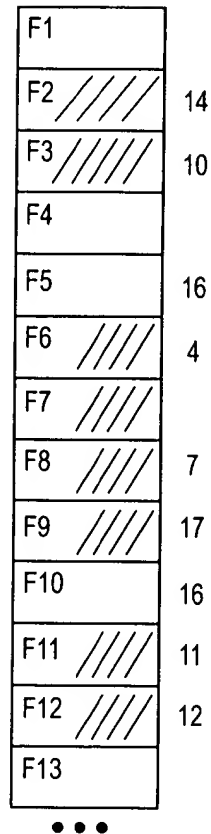


FIG. 52

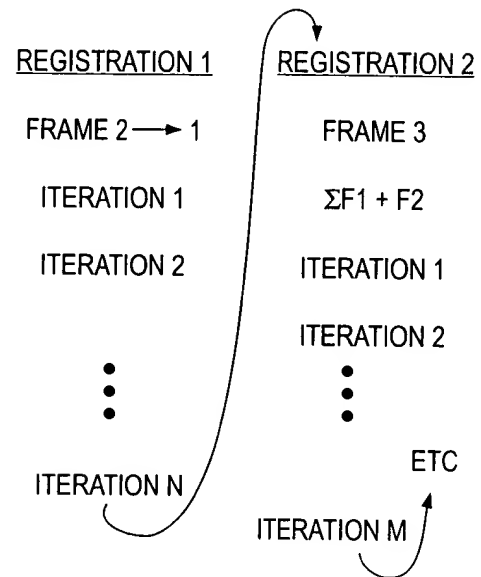
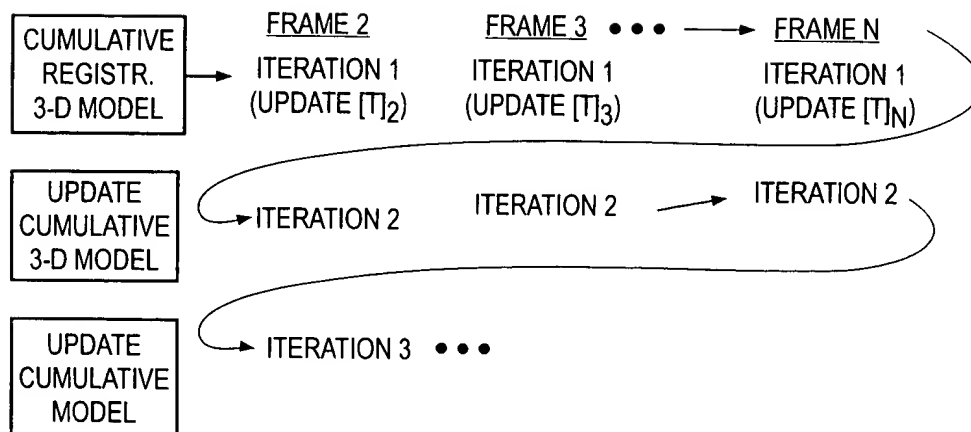


FIG. 53



40/51

☒ Single
☐ Cumulative

X	Y	Z
0.00	0.00	0.00
3.00	0.00	0.00
-3.00	0.00	0.00
0.00	3.00	0.00
0.00	-3.00	0.00

Registration (raw)

Distance limit (SYX)

Stationary count

Radius (SYX)

Convergence factor

Number of points to register

Accelerate factor

Registration (raw + fine)

Maximal iteration count

Overlap size

Minimum quote of active points (0..1)

Maximal triangle size (larger triangles are treated as gaps)

Maximal edge length (longer edges have no attraction)

Maximal count of unsuccessful files new segment is started when exceeded

Form factor: Proportion of point distance and element size (≥ 0)

Registration (line)

Distance limit (SYX)

Final distance

Stationary count

Radius (SYX)

Convergence factor

Number of points to register

Accelerate factor

general

Count of SYX surfaces for animation (0= off) Cell size

☒ Combine frames cumulative

☒ Combine segments cumulative

Merging

Radius of sphere inside which is to replace Minimal triangle plane size for closing gaps Minimal distance from point of base quantity

Maximal count of edge lines for closing gaps Maximal edge length for closing gaps Maximal distance from edge of base quantity

FIG. 54

41/51

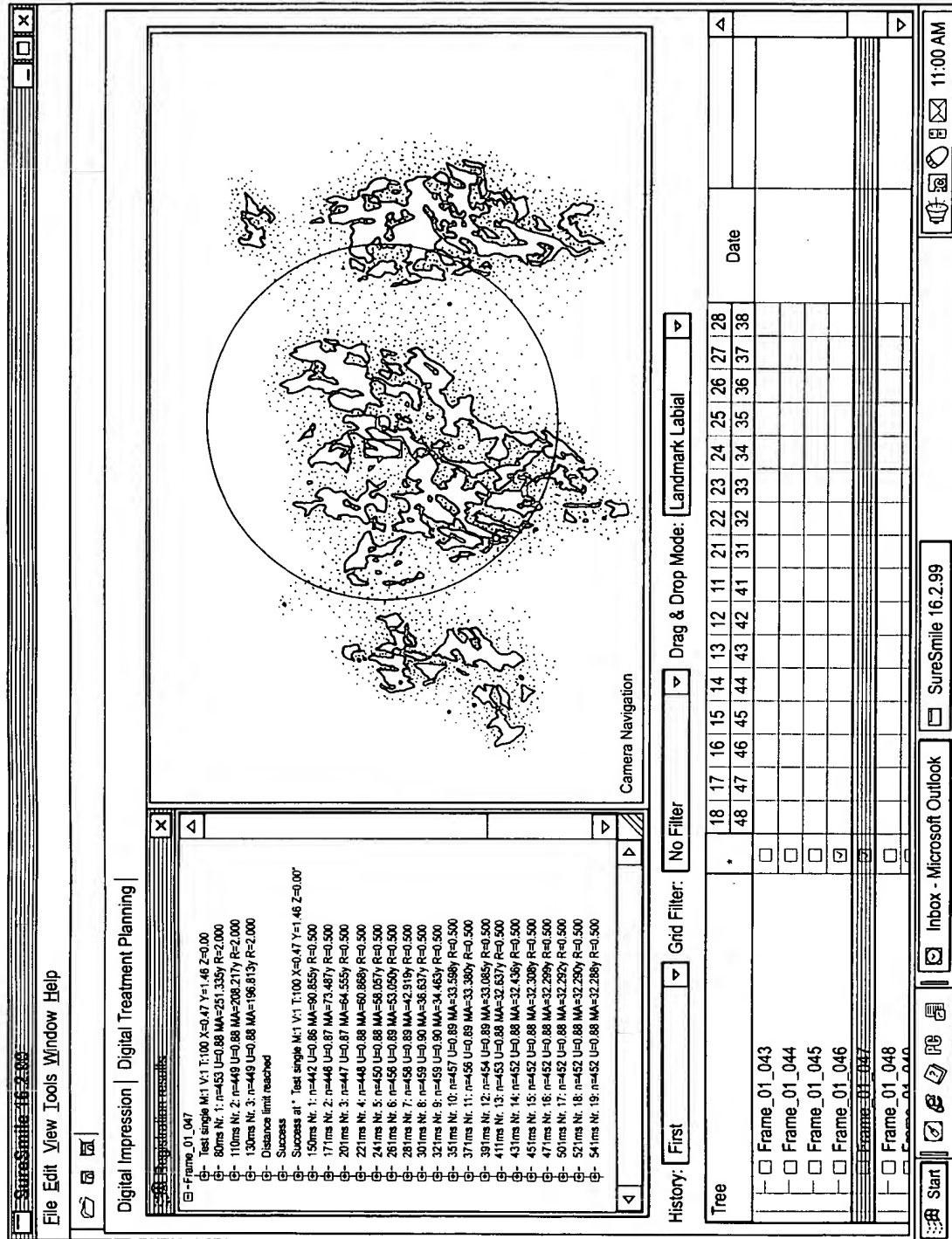
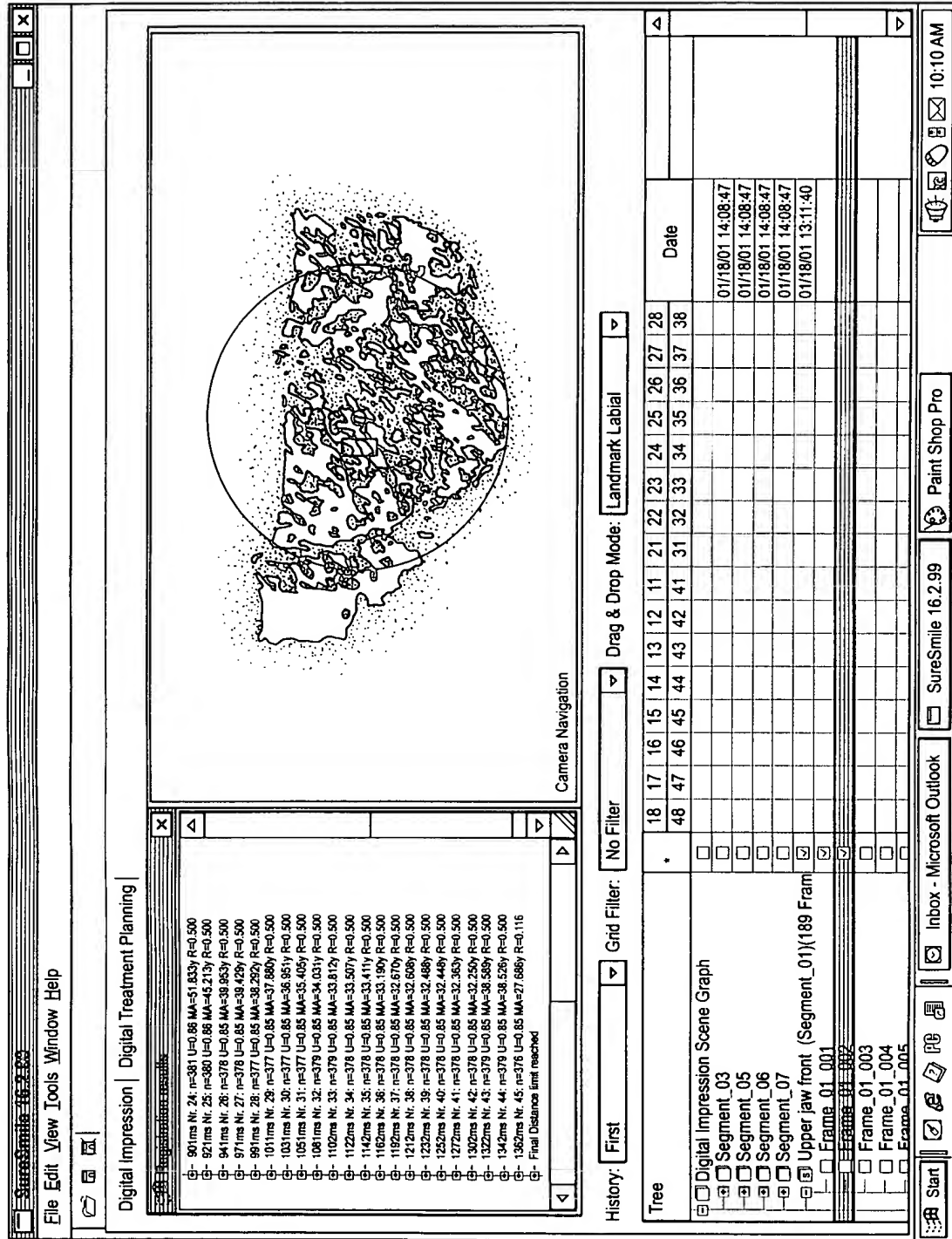
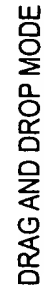


FIG. 55

42/51



43/51



LANDMARK LABEL

Diagram illustrating the upper jaw front segment (UPPER JAW FRONT (SEGMENT)). The segment is divided into 11 teeth, numbered 18 through 28. A bracket labeled 301 indicates the entire segment. A bracket labeled 306 indicates a specific region spanning teeth 13 through 23, with a small black square marker positioned below tooth 14.

44/51

Fig. 58A

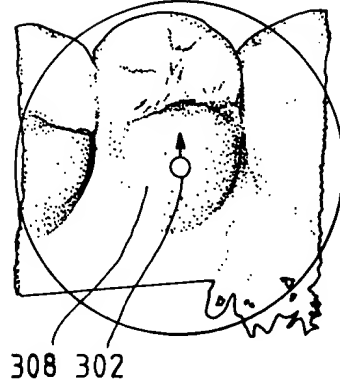


Fig. 58B

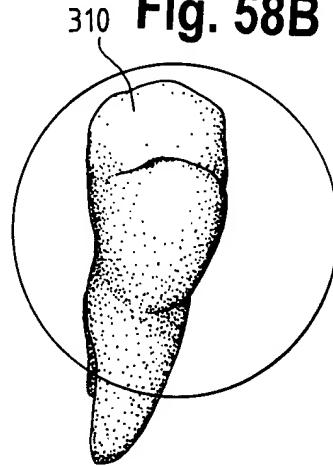


Fig. 58C

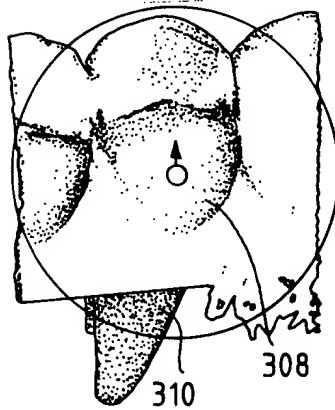


Fig. 58D

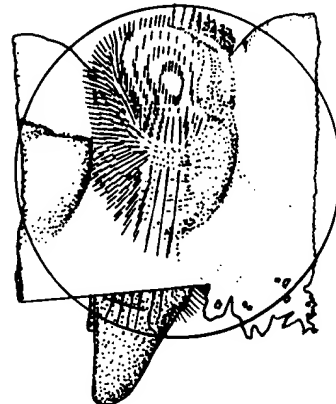


Fig. 58E

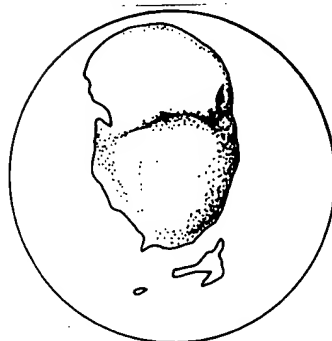
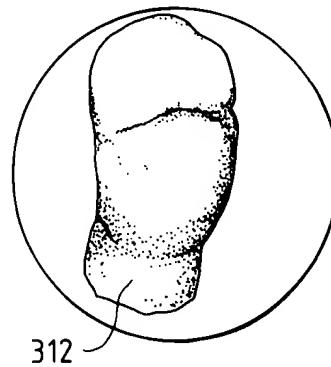
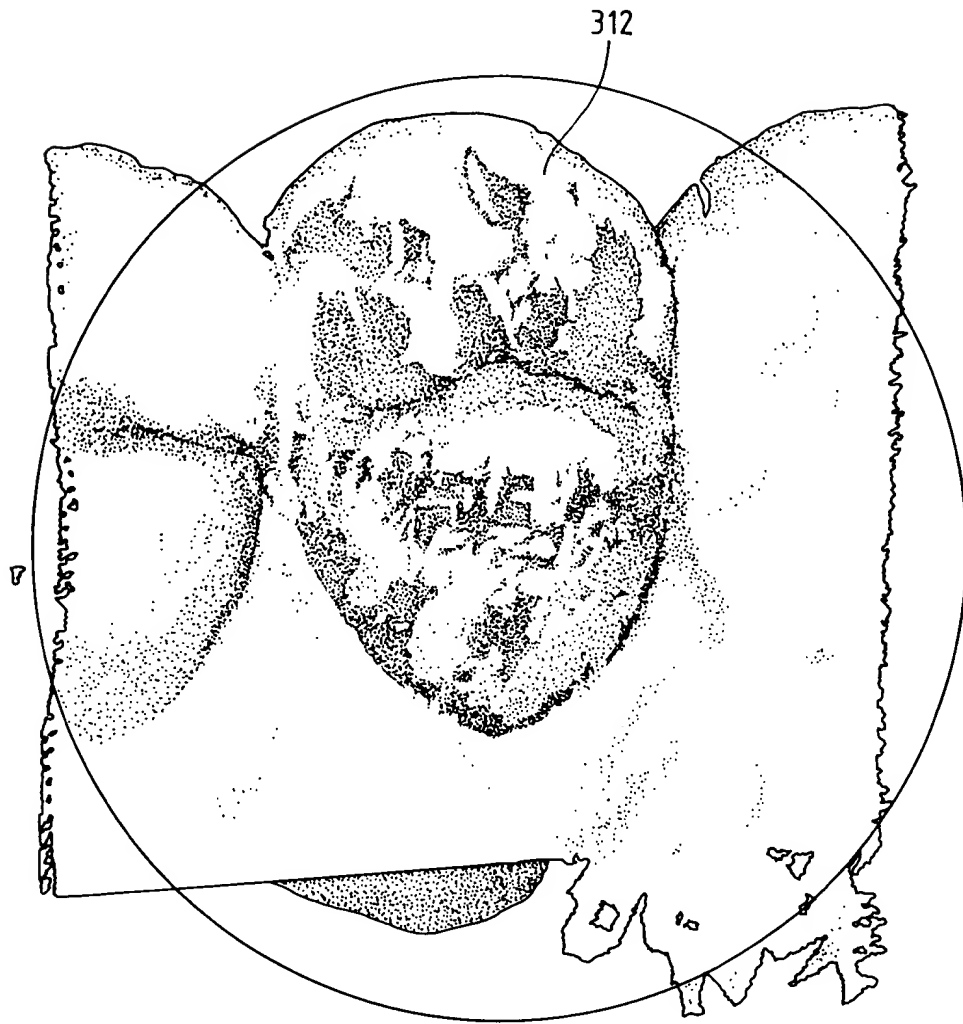


Fig. 58F

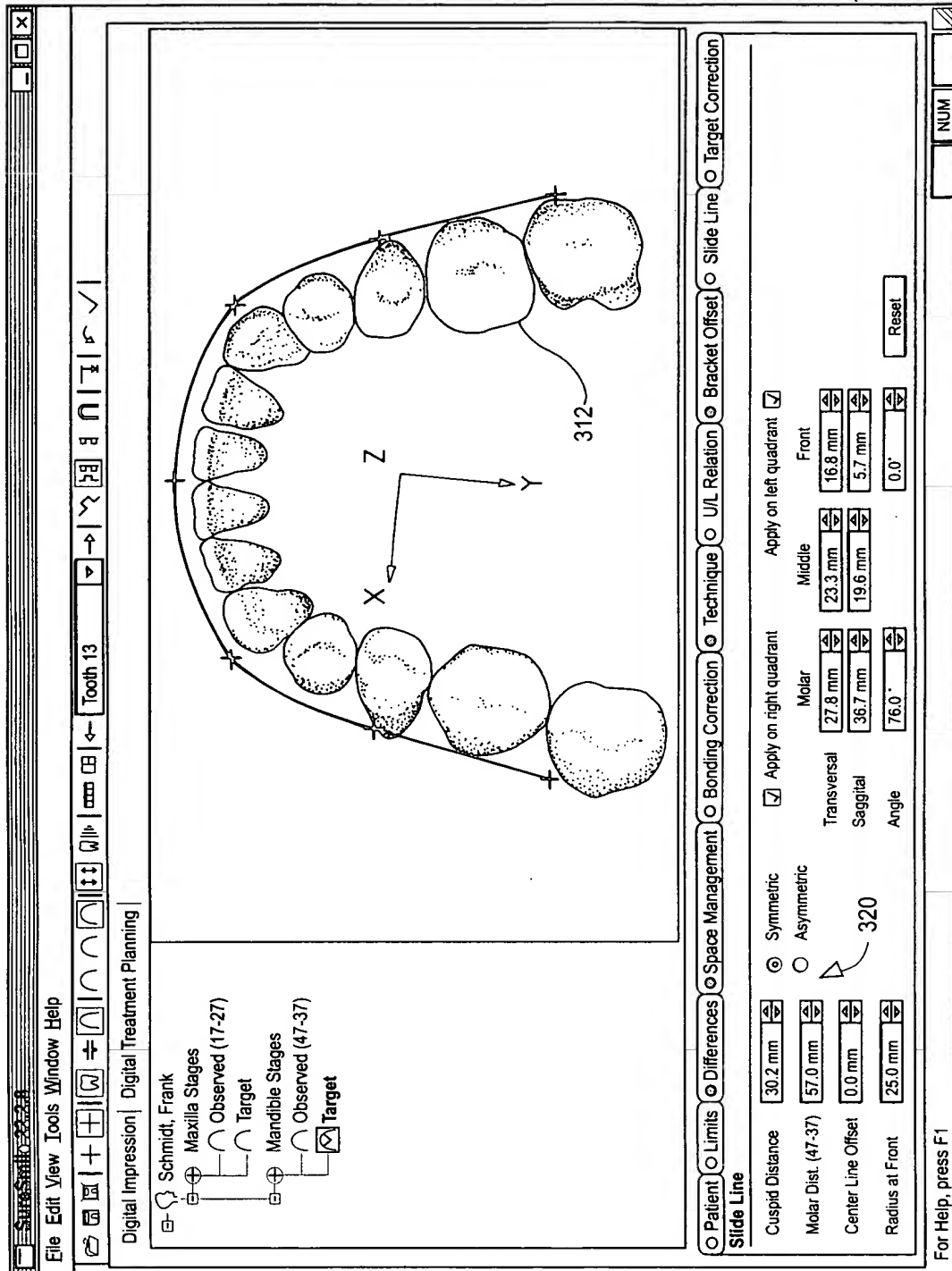


45/51

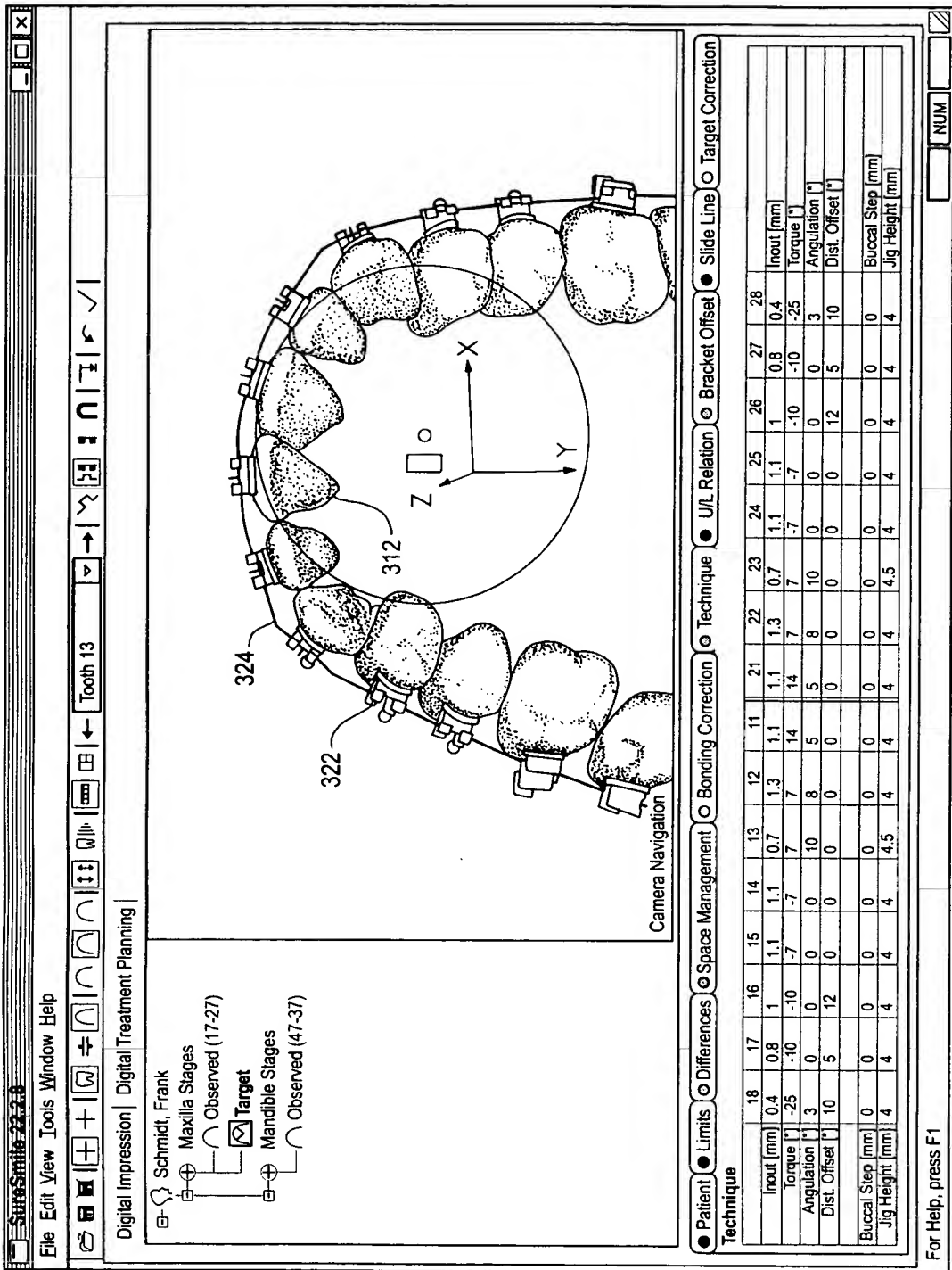
Fig. 59



46/51



47/51



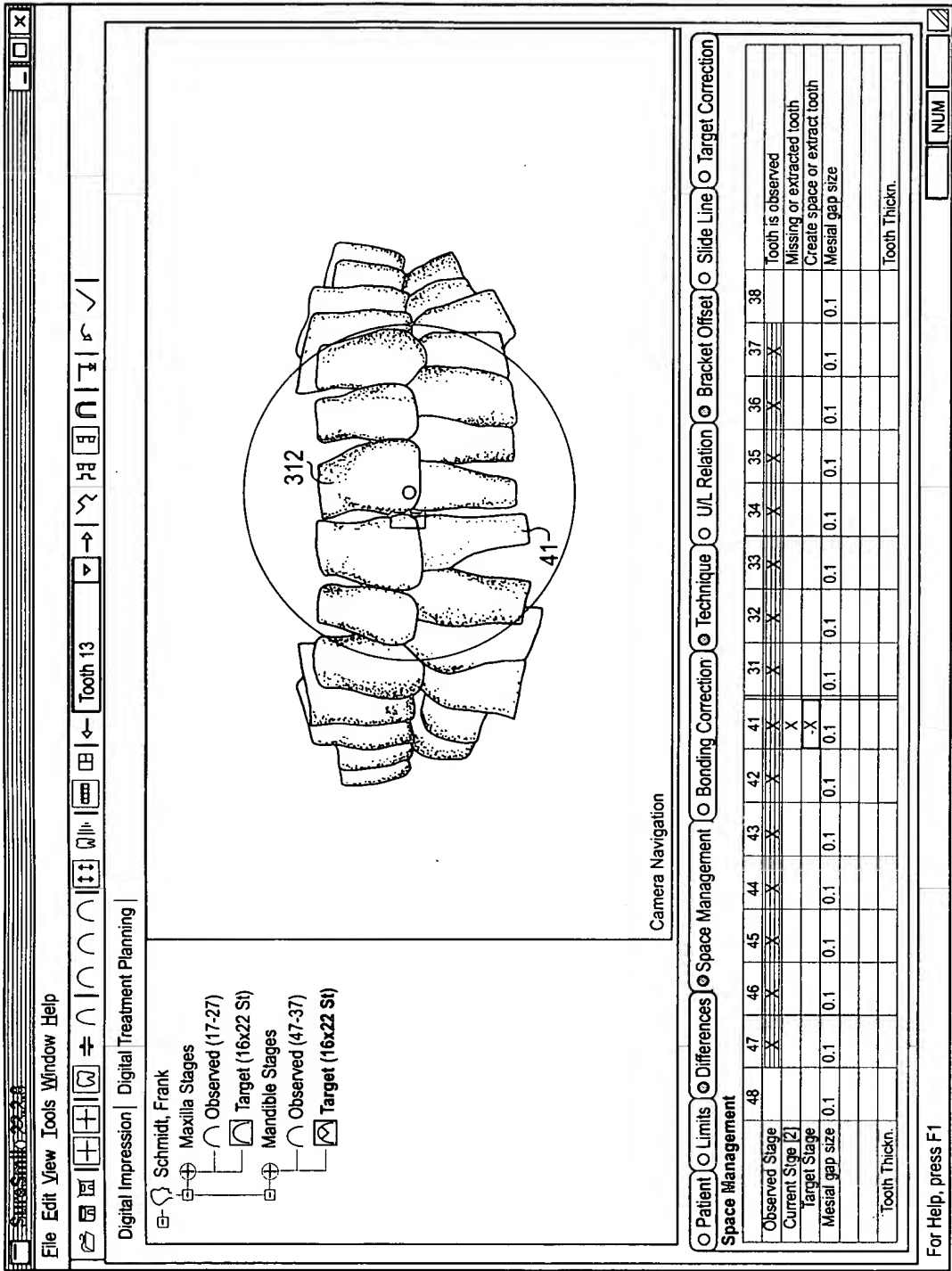
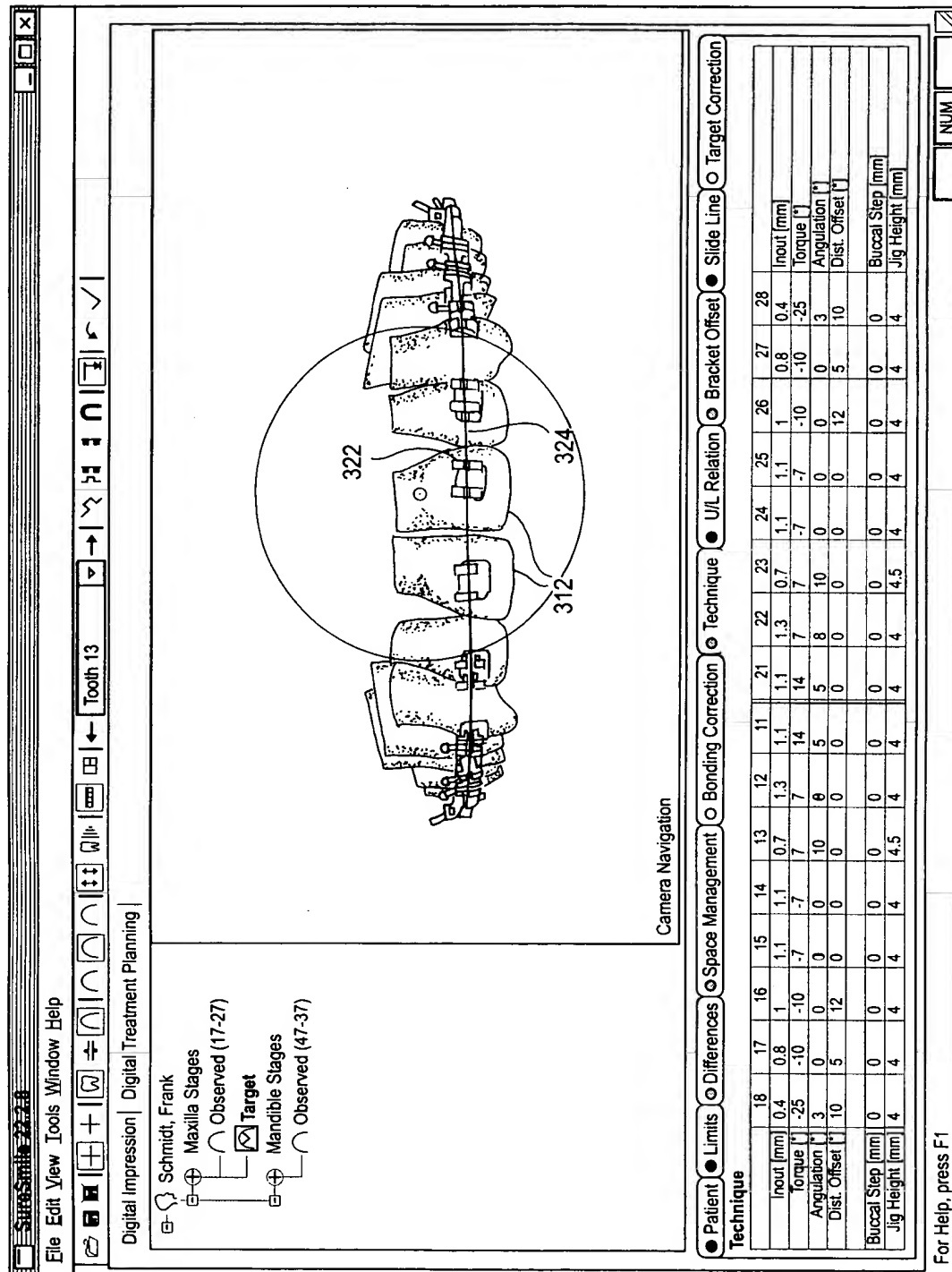


FIG. 63

49/51



50/51

Fig. 64A

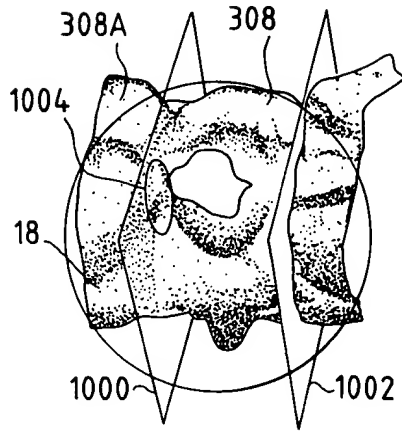


Fig. 64B

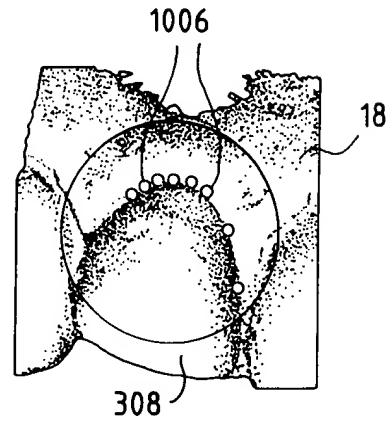


Fig. 64C

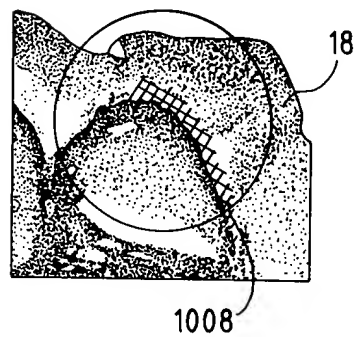


Fig. 64D

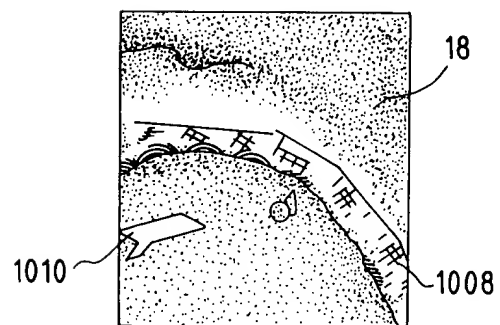


FIG. 65

